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Physics Abstracts

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Lines and networks
Waveguides
Photocells
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PHYSICS ABSTRACTS

Volume 59 JUNE 1956 Number 702

MATHEMATICS 51

518.2

4144. TABLES OF WEBER PARABOLIC CYLINDER FUNCTIONS. Edited by J.C.P.Miller.
London: H.M.Stationery Office (1955) 233 pp.

The title is an understatement, since the first half of this book contains a comprehensive account of the solutions of the equations $y'' \pm (\frac{1}{4}x^2 - a)y = 0$ and their properties, as well as a long list of formulae. The main tables are tables of solutions $W(a, x)$ and $W(a, -x)$ of $y'' + (\frac{1}{2}x^2 - a)y = 0$, whose Wronskian is unity, and their derivatives to the eighth order, or an order sufficiently high for interpolation, in the ranges $a = -10(1)10$, $x = 0(0.1)10$, to 8-9 significant figures. Subsequently there are tables of $\log W(a, x)$ and its derivative $a = 1(1)10$, $x = 0(0.1)2\sqrt{a}$ and auxiliary functions giving the modulus and argument in regions in general where the solutions oscillate, i.e. $x = 2\sqrt{a}(0.1)10$ for $a = 3(1)10$ and $x = 0(0.1)10$ for $a = -10(1) + 2$. Later there are tables of gamma functions and other constants which occur in the exposition of properties. G.J.Kynch

518.5

4145. ON STARTING ROUTINES FOR THE C.S.I.R.O. MARK I COMPUTER. G.W.Hill and T.Pearcey.
Austral. J. Phys., Vol. 8, No. 3, 412-16 (Sept., 1955).

The routines are set out in detail in a special notation, knowledge of the machine organization being assumed. The paper deals with the design of the routine and not with the associated technical details. A.J.Kennedy

518.5 : 548.74

4146. USE OF PUNCHED CARD MACHINES FOR COMPUTING SUMS OF PRODUCTS. THE APPLICATION TO ELECTRON DIFFRACTION CALCULATIONS. J.Bregman.
J. chem. Phys., Vol. 24, No. 2, 405-7 (Feb., 1956).

A punched card procedure for computing sums of products is described. It requires only a small card file and machines that may be available in IBM installations not set up primarily for scientific computation. The application to electron diffraction calculations is described. A.

519.2

4147. A THEORY OF CERTAINTY. I. DEFINITIONS AND PROPERTIES. M.Castañs Camargo.
An. Real. Soc. Españ. Fís. Quím. Vol. 51(A), No. 9-10, 215-32 (Sept.-Oct., 1955). In Spanish.

If $p_1, p_2 \ldots p_n$ are the probabilities of a given measure having one of n discrete values, a function

$$\Gamma(n, p_1, p_2 \ldots p_n) = \log_2 n + \sum_{i=1}^{n} p_i \log_2 p_i$$

is defined which tends to a maximum in the same manner as entropy. For a continuous distribution a similar function containing a definite integral is derived. This quantity is evaluated for a number of distributions over a finite range and for the Gaussian distribution. It is shown that the Gaussian is the most probable for a large number of observations. N.Corcoran

519.2 : 53.088

4148. A THEORY OF CERTAINTY. II. APPLICATION TO METROLOGY. M.Castañs Camargo.
An. Real. Soc. Españ. Fís. Quím., Vol. 52(A), No. 1-2, 43-58 (Jan.-Feb., 1956). In Spanish.

A mathematical discussion of theory of errors on the postulate that errors above a certain size are impossible (not very improbable, as on the Gaussian treatment). A formula is obtained which gives the probability that the true value lies between any two given limits. The size of the graduations of the measuring instrument is taken into account. An expression is also obtained which serves as a numerical measure of the departure from the Gaussian distribution. N.Corcoran

519.281.2 : 53.081 : 539.154

4149. STANDARD ERRORS OF THE RESIDUES IN A LEAST-SQUARES ANALYSIS. E.R.Cohen.
Phys. Rev., Vol. 101, No. 6, 1641-2 (March 15, 1956).

The covariance matrix between input and output data of a least-squares analysis is computed and hence the standard error of a residue may be evaluated. This leads directly to a means of evaluating the consistency of the data more precisely than is usually the case. This result is applied to the analysis of data on the atomic constants by DuMond and Cohen (Abstr. 2330/1956). A.

ASTRONOMY . ASTROPHYSICS . GEODESY 52

522.21 : 535.313

4150. RESEARCHES BEARING ON TELESCOPES PROVIDED WITH A CORRECTOR PLATE. L.Oterma.
Ann. Univ. Turku A, Vol. 19, No. 1, 134 pp. (1955). In French.

This publication is a manual of design based on calculations, supported by actual experimental telescopes. The first part gives the general formulae for geometrical optics with the symbols used in the work. The second section deals with optical systems composed of a mirror and a corrector plate. The profile of the plate is calculated to a high degree of accuracy. The third portion contains the study of anastigmatic systems which employ a correcting field flattening lens, and later the use of an aspherical main mirror is discussed. Numerical examples of the various systems are given to control the theoretical researches. A short list of references is given but this contains nothing more recent than 1950. E.G.Martin

522.612

4151. THE ROLE OF PLATE SATURATION IN THE LIMITATION OF THE (STAR) MAGNITUDES ATTAINED BY CLASSICAL PHOTOGRAPHY AND WITH THE AID OF THE ELECTRON TELESCOPE. P.Vernier.
C.R. Acad. Sci. (Paris), Vol. 242, No. 8, 1006-8 (Feb. 20, 1956). In French.

The five-metre telescope at Mount Palomar cannot photo-

graph stars weaker than magnitude 24 because of photographic plate saturation caused by the general sky background (30 min exposure). It should be possible by using an electron telescope to increase the number of developed grains in the plate per incident photon and so reduce the statistical fluctuations in this background. This would enable the presence of weaker stars to be detected. By making certain simplifying assumptions about the response of photographic plates to electrons, it is calculated that an electron telescope of unity magnification and 10% cathode efficiency fitted to the Mount Palomar telescope should enable stars of magnitude 27 to be detected with exposures of a few hours. A.E.I. Research Laboratory

522.617 : 621.375.2.024

4152. INTEGRATOR-TYPE D.C. AMPLIFIER. A.J.Gardiner and H.L.Johnson.
Rev. sci. Instrum., Vol. 26, No. 12, 1145-7 (Dec., 1955).

A d.c. amplifier that uses the condenser-charging principle of electron counting has been constructed and used for the measurement of stars as faint as magnitude 20.8 with the 82-inch and 100-inch telescope. The device is simple (15 tubes), will measure stars of any brightness permitted by the photomultiplier, and has a simple automatic recording feature using a Brown recording meter. A.

522.92

4153. INFLUENCE OF THE TERRESTRIAL ATMOSPHERE ON ASTRONOMICAL OBSERVATIONS. M.G.Fracastoro.
Atti. Fond. Ronchi, Vol. 10, No. 6, 492-99 (Nov.-Dec., 1955). In Italian.

A brief review of the allied problems of atmospheric optical extinction, and irregularity ("seeing") as applied to the precision photometry of stellar images. D.R.Barber

523.11 : 523.852

4154. THE FORMATION OF THE NEBULAE. W.B.Bonnor.
Z. Astrophys., Vol. 39, No. 3, 143-59 (1956).

The growth of condensations in the pressure-free cosmological models of general relativity (with $\Lambda = 0$) is studied by using a simplified model of a condensation. It is shown that, although condensations can form from quite small perturbations in the density of the cosmic medium, the perturbations required to account for the formation of the nebulae by the present time are nevertheless much larger than those which would be expected from ordinary statistical theory. The Lemaitre point-source model (with $\Lambda \neq 0$) seems no more favourable to the growth of condensations. It is concluded that unless some source of larger perturbations can be discovered, it will be necessary to abandon the point-source models in favour of others with a longer time-scale, for example, the disturbed Einstein model. A.

523.112

4155. THE SHRINKING HORIZON IN THE STEADY-STATE THEORY OF THE EXPANDING UNIVERSE. S.Gupta.
Curr. Sci., Vol. 24, No. 8, 263-4 (Aug., 1955).

The "effective theoretical horizon" for an observer A at time t_0 is defined to be the distance travelled by a light pulse from A in time t_0 to infinity. This is found to be $k^{-1}e^{-kt_0}$, where k is Hubble's constant, and is employed in a discussion of Whitrow's paradox. R.A.Newing

523.12

4156. VECTOR-TETRADS AND THE CREATION OF MATTER. W.H.McCrea and F.I.Mikhail.
Proc. Roy. Soc. A, Vol. 235, 11-22 (April 10, 1956).

The possibility is examined of using a tetrad vector field to provide field relations that admit the creation of matter. Except for additive terms in certain auxiliary tensors depending on only first derivatives of the field, it is shown that a tetrad field determines two and only two linearly independent tensors corresponding in complexity to the single Ricci tensor of Riemannian geometry. It is suggested that combinations of these tensors might serve as the Einstein tensor and the 'creation tensor' in F. Hoyle's proposed modification of Einstein's field relations. Certain tetrad fields discovered by H.P.Robertson and A.G.Walker are shown to conform to the cosmological principle in a required sense. Using these in field relations of the suggested form, equations for cosmological models are obtained. One such model closely resembles that derived by Hoyle. So far as they go, the indications obtained in the paper are that tetrad fields may be appropriate for the further mathematical study of the possibility of continuous creation. A.

523.16 : 532.5 : 538.56

LINE CURRENTS IN COSMIC PHYSICS. See Abstr. 3847

523.16 : 532.5 : 538.56

HYDROMAGNETIC WAVES IN RARE IONIZED GAS AND GALACTIC MAGNETIC FIELDS. See Abstr. 3850

523.165 : 532.5 : 538.56

ON THE ACCELERATION OF COSMIC-RAY PARTICLES BY MAGNETO-HYDRODYNAMIC WAVES. See Abstr. 3858

523.7 : 532.5 : 538.56

TORSIONAL OSCILLATIONS AND SOLAR MAGNETIC FIELDS. See 3849

523.752

4157. THE NUMBER OF H ATOMS AT LEVELS, n = 1 AND n = 2, IN THE SOLAR CHROMOSPHERE. C.Pecker and J.C.Pecker.
C.R. Acad. Sci. (Paris), Vol. 242, No. 9, 1130-2 (Feb. 27, 1956). In French.

Significant differences of gradient are shown to exist when values of log (no. of H atoms in state 2 per cm^3) are plotted against height of the chromospheric level of emission above photosphere, for the two cases, (a): H emission from homogeneous chromosphere, and (b): Balmer emission from chromospheric 'spicules' only. D.R.Barber

523.755

4158. SOME PHYSICAL ASPECTS OF THE CORONA. A.M.Cormack.
Monthly Notes Astron. Soc. S. Africa, Vol. 15, No. 1-2, 2-6 (Feb., 1956).

A concise summary of the major established features of the solar corona, with a brief discussion of certain outstanding problems awaiting solution in order to provide a complete physical picture of the solar atmosphere. D.R.Barber

523.79

4159. THE SOLAR SPECTRUM FROM 2.8 TO 23.7 MICRONS. I. PHOTOMETRIC ATLAS. M.Migeotte, L.Neven and J.Swensson.
Mem. Soc. Roy. Sci. Liège, Vol. Hors Série, No. 1, 118 diagrams (1956). In English and French.

The Atlas is an extension of the "Photometric Atlas of the Near Infra-red Solar Spectrum, λ 8465 to λ 25242" by O.C.Mohler, A.K.Peirce, R.R.McMath and L.Goldberg (Univ. Michigan Press, Ann Arbor, 1950). Part II, dealing with spectral measures and identifications, is in preparation. D.R.Barber

523.852

4160. ON THE ISOPHOTES OF ELLIPSOIDAL NEBULAE. G.Contopoulos.
Z. Astrophys., Vol. 39, No. 2, 126-32 (1956).

It is proved that the isophotal curves of a projected nebula are similar concentric ellipses if the space distributio is ellipsoidal, i.e. if the isophotal surfaces are similar concentric ellipsoids. In the case of a finite nebula the limiting ellipse is found. From the ratio of its axes and the radial velocities of its points the orientation of the ellipsoid can be deduced. Finally a test is proposed for checking if a given nebula is spheroidal or not. A

523.872 : 523.161

4161. COLLISIONAL EMISSION SPECTRA OF COSMIC CLOUDS. S.Miyamoto.
Z. Astrophys., Vol. 38, No. 4, 245-58 (1956).

General features of collisional emission spectra of cosmic clouds have been examined and compared with those due to radiative excitation. A figure illustrates the temperature sequence of collision spectra. In the case of a collision spectrum, (i) forbidden emissions appear much stronger than the Balmer lines, and (ii) simultaneous appearance of [O I], [O II] and [O III] cannot be expected, contrary to the radiative spectrum. The theory was applied to the interpretation of Cygnus A, the radio source in Cassiopeia, the network nebulae in Cygnus and M 16. Emission intensity depends also upon the electron density. The basic difference between the collision and radiation excitation lies in the type of ionization equilibrium. The latter leads to the Saha formula with dilution factor, while the former leads to the new type found in the solar corona. Their difference appears most clearly in the density dependence of the emission line intensities. In fact, the density dependence varies according to the line and to the excitation mechanism, and thus it serves to discriminate between collision and radiation spectrum. Observationally the variation of an intensity ratio such as $H_\beta : N_1 + N_2$ across the filaments or nebulous patterns is useful to the discrimination. For the network nebulae, observation seems to favour collisional excitation, while for M 16 and M 20 radiative excitation seems more plausible. A.

523.877

4162. EFFECT OF MAGNETIC FIELD ON GRAVITATING SPHERES. F.C.Auluck and D.S.Kothari.
Z. Astrophys., Vol. 38, No. 4, 237-44 (1956).

The problem discussed by Ferraro on the flattening of a gravitating sphere is worked out using the "energy method" of Chandrasekhar and Fermi. The result is identical with that given by Ferraro. In the last section an extension of Ferraro's problem is considered, such that the field vanishes at the centre of the sphere and has a constant value H_0 at large distances from the sphere. In this case the equilibrium configuration is a prolate spheroid. A.

529.786

4163. CONSTRUCTION AND PERFORMANCE OF NEW QUARTZ CLOCKS AT THE PHYSIKALISCH-TECHNISCHEN BUNDESANSTALT. A.Scheibe, U.Adelsberger, G.Becker, G.Ohl and R.Süss.
Z. angew. Phys., Vol. 8, No. 4, 175-83 (1956). In German.

Improvements are described in the design of the quartz crystal holder, the electrode assembly, the thermostat and the circuitry, resulting in a reduction in the magnitude of the random fluctuations and of the ageing effect to almost negligible amounts (of the order of 3×10^{-8} sec/day). H.J.H.Starks

PHYSICS 53

53 : 37

4164. SOME COMMENTS ON THE NATURE OF PHYSICAL THEORY AND THEIR THEORETICAL AND PEDAGOGICAL IMPLICATIONS. R.Barthel.
Amer. J. Phys., Vol. 24, No. 4, 268-72 (April, 1956).

An analysis of the nature of physical theory brings out the rational origin of some of the fundamental principles of modern physics and makes clearer the proper attitude of physicists toward their science. The pedagogical importance of this analysis is accentuated. A.

53 : 371

4165. THE NEED FOR TRAINED INTELLIGENCE. G.W.Giddings.
Amer. J. Phys., Vol. 24, No. 5, 334-40 (May, 1956).

Three aspects of the need for highly intelligent trained people are discussed: the need for more understanding of some of the problems of education, the need for a more enlightened attitude on the part of industry in using trained intelligence, and the need for intelligent acceptance of our social responsibilities. A.

53 : 371

4166. TEACHING PERFORMANCE. E.Hutchisson.
Amer. J. Phys., Vol. 24, No. 4, 214-24 (April, 1956).

An attempt is made to analyse the qualities that enter into good teaching. A parallel is drawn between performance measurement in the management field and that in teaching. Both contain highly emotional components which are difficult to measure. Both also contain components which can be measured and which are generally susceptible to improvement. Further analysis of the measurable components may require a joint study programme by a large group of teachers and some suggestions are made for such a joint programme. A better understanding of these components should result in better over-all teaching performance. A.

53 : 371

4167. WHERE DO WE GET THE TEACHERS? D.D.Henry.
Amer. J. Phys., Vol. 24, No. 5, 322-8 (May, 1956).

Estimates of the requirements for new teaching personnel in colleges and universities indicate that a serious shortage is impending within the decade 1960-1969. Measures currently being practiced are inadequate to fill the need. A more active recruitment and training programme on the part of the universities is advocated. The obligation of industry to avoid undermining educational programmes by recruiting staff members away from colleges and universities is emphasized. A.

53 : 371

4168. SUMMER INSTITUTES FOR HIGH SCHOOL SCIENCE TEACHERS. R.L.Weber.
Amer. J. Phys., Vol. 24, No. 5, 328-33 (May, 1956).

Increasing college enrolments, and the needs of both industry and the national welfare for capable, technically trained personnel emphasize the desirability of special supplemental programmes for increasing the competence of high school teachers of science and mathematics. The growth of interest in summer science institutes, their financial support, and their effectiveness are discussed. A.

53.081 : 531.711

4169. NEW SYSTEM OF PHYSICAL UNITS AND STANDARDS. B.F.Ludovici.
Amer. J. Phys , Vol. 24, No. 5, 400-7 (May, 1956).

The present system of physical units and standards is critically examined with a view to the possible destruction of the present primary standards through a natural catastrophe. A new system is proposed. A.

FUNDAMENTALS 530.1

530.12

4170. ON THE CHARACTERISTIC VARIETIES OF EINSTEIN'S UNIFIED FIELD THEORY. F.Maurer-Tison.
C.R. Acad. Sci. (Paris), Vol. 242, No. 9, 1127-9 (Feb. 27, 1956). In French.

530.12

4171. NONCLASSICAL TRANSFORMATION IN SPECIAL RELATIVITY. R.Reulos.
Phys. Rev., Vol. 102, No.2, 535-6 (April 15, 1956).

In a previous article, a Lorentz transformation was considered in the general case in which the velocity which generates the transformation is no longer parallel to one of the axes of coordinates. It was noticed that the general form of this transformation, which is no longer linear with respect to the components of the velocity, could not be conveniently applied to certain problems of wave mechanics. A general transformation is given here, linear with respect to the components of the velocity, which is connected with Hamilton's quaternions and Dirac's matrices. Although the transformation is complex, it may, in certain problems, replace with advantage the Lorentz transformation. In the realm of wave mechanics, the formalism used, by a simple transformation of the wave functions and of the well-known Einstein relation $W = h\nu$, enables a very general system of equations to be obtained which contains Proca's equations, de Broglie's equations of the photon, and the Maxwell–Lorentz equations. The method leads to the consideration of the equations of electromagnetism as a natural generalization of the Cauchy–Riemann conditions and electromagnetic fields as generalization of analytic functions, the variable being a quaternion. A.

530.12

4172. ON GRAVITATIONAL THEORIES OF WHITEHEAD'S TYPE. A.Schild.
Proc. Roy. Soc. A, Vol. 235, 202-9 (April 24, 1956).

An infinity of gravitational theories are obtained which, like Whitehead's theory, are action-at-a-distance theories. The motions of mass particles and of light rays in the gravitational field of a single heavy particle at rest are the same as in Einstein's general theory of relativity. A.

530.12

4173. ON LINEAR FIELD THEORY. IV. STATIC FIELDS. W.Scherrer.
Z. Phys., Vol. 144, No. 4, 373-87 (1956). In German.

For Pt III, see Abstr. 8468/1955. It is shown that, for static spherically symmetric fields and zero cosmological constant, the action function may be expressed in terms of two invariants in the form $W_3 - (1 + \omega)W_2$, where the parameter ω is such that $-2/3 < \omega < 1$, the case $\omega = 0$ corresponding to general relativity. There are six structurally different solutions of the field equations for $\omega < 0$, and four for $\omega > 0$, but attention is here restricted to a solution which passes continuously into the Schwarzschild solution as $\omega \to 0$. This solution gives a perihelion advance and a gravitational deflection of light which are respectively $(12 - 5\omega)/12(1 - \omega)$ and $\frac{1}{2}(2 - \omega)/(1 - \omega)$ times the values derived from the general theory of relativity. There is no change in the estimation of the gravitational shift of spectral lines. R.A.Newing

530.12

4174. (JORDAN'S) EXTENDED GRAVITATION THEORY AND PERIHELION ROTATION. K.Just.
Z. Phys., Vol. 144, No. 4, 411-27 (1956). In German.

In a previous discussion of planetary motion (Abstr. 7669/1955) it was assumed that the geodesic principle remained valid in the extended theory. This is found not to be the case, the equations of motion for an uncharged test particle being of the form

$$v^\nu v^\alpha{}_{\|\nu} + \tfrac{1}{2}\gamma(\sigma^{\|\alpha} + \sigma v^\alpha) = 0,$$

the additional term involving γ arising from the scalar b associated with the matter field (Abstr. /1956). The constant γ denotes the ratio $[b]/[\epsilon]$, where ϵ is the mass density and

$$8\pi\kappa^c_\infty [b] = \int b(-g)^{\frac{1}{2}} \kappa^{c+1} dx^3,$$

the integration being throughout the rest-volume of the particle. The calculated perihelion advance agrees approximately with general relativity if $|\gamma\Gamma| < 0.015$, where Γ is the ratio corresponding to γ for the sun. The condition for exact agreement is $(c-\gamma)(c-\Gamma) = 0$ and this is shown to include the special case $b + cT = 0$. The following general theorem is noted: if $b + cT = 0$, all static solutions of the extended field equations for which κ tends to a constant value at infinity are identical with those of general relativity. R.A.Newing

530.12

4175. THE EÖTVÖS TORSION BALANCE (EXPERIMENT) IN THE CASE OF VARIABLE GRAVITATIONAL NUMBER. K.Just.
Z.Phys., Vol. 144, No. 5, 648-55 (1956). In German.

In Jordan's theory of gravitation, the equations of motion of a test particle involve an additional γ-term dependent on the nature of the particle (preceding abstract) and this may involve a variation of plumb-line direction with the material of a suspended weight. The null result of the Eötvös (1922) experiment is used to show that for any two different particles

$$|(\gamma_2 - \gamma_1)\beta| < \tfrac{1}{2} \times 10^{-7}, \text{ where } \beta = (\Gamma - c)/[2(s + 2c^2) - c\Gamma].$$

R.A.Newing

530.12 : 530.145

4176. ON THE SPINOR MECHANICS OF A POINT CHARGE. A.Proca.
J. Phys. Radium, Vol. 17, No. 2, 81-2 (Feb., 1956). In Frenc

The author's mechanics (Abstr. 5264/1954) is modified by supposing that space-time and spinor space are related by the equation $e(dx^\rho/d\tau) = \xi^+\gamma^\rho\xi$, where e is the electric charge on the particle. In this case $\Omega_1^2 + \Omega_2^2 = c^2e^2$, where Ω_1 and Ω_2 are the invariants $-i\xi^+\xi$ and $\xi^+\gamma^5\xi$, Ω_1 being constant throughout the motion of the particle. If Ω_2 is taken to be zero, results previously obtained remain valid. R.A.Newing

530.12 : 530.145

4177. ON A NEW PRINCIPLE OF EQUIVALENCE SUGGESTED BY SPINOR MECHANICS. A. Proca.
J. Phys. Radium, Vol. 17, No. 2, 83-4 (Feb., 1956). In French.

When the invariant Ω_2 is non-zero, e^2c^2 and the spin "length" $\frac{1}{2} m_{\mu\nu}m^{\mu\nu}$ are not constants of motion but their sum is $2\Omega_1^2$ and is constant for a large class of interactions. It is suggested that it may be possible to introduce a spin-charge equivalence in a quantized form of the theory. R.A.Newing

530.12 : 538.3

4178. PROJECTIONS OF NULL GEODESICS AND ELECTR MAGNETIC RAYS IN A MEDIUM IN A STATE OF PERMANENT MOTION. Pham Mau Quan.
C.R. Acad. Sci. (Paris), Vol. 242, No. 7, 875-8 (Feb. 13, 1956). In French.

The rays are the projections on the 3-space $d\sigma^2 = (g_{ij} - g_{oi}g_{oj}/g_{oo})dx^i dx^j$ of the null geodesics of the 4-space defined by the metric $\gamma_{\alpha\beta}$ (Abstr. 3466/1956). This result is represented as a relativistic generalization in the 3-space of Fermat's principle of least time. R.A.Newing

530.14

4179. ON A FORM OF EINSTEIN'S PARADOX OF QUANTU THEORY. L. Jánossy and K.Nagy.
Ann. Phys. (Leipzig), Vol. 17, No. 2-3, 115-21 (1956). In German.

Using an example for the elucidation of the physical meaning of the superposition of states, the authors arrive at a formulation of the problem similar to Einstein's.

W.A.Hepne

530.14

4180. CONSERVATION LAWS AND QUANTUM MECHANICAL OPERATORS. P.Román.
Acta phys. Hungar., Vol. 5, No. 2, 143-58 (1955). In Germar

This paper deals with the derivation of conservation laws

from the condition of the invariance of the Lagrangian (which may contain higher-order derivatives) under certain transformations. W.A.Hepner

530.145

4181. FLUCTUATION DISSIPATION THEOREM. J.Weber.
Phys. Rev., Vol. 101, No. 6, 1620-6 (March 15, 1956).

The fluctuation dissipation theorem (Nyquist formula) is shown to be exact and a number of generalizations of it are given, including a four-dimensional formulation which is useful in the quantum theory of fields. The more general theorem can be used to calculate vacuum expectation values of field operators, and to deduce covariant commutation relations for the fields. For a four-potential field, the vacuum expectation values for operators at two space-time points x and x' are

$$\langle A_\mu(x)A_\alpha(x')\rangle_0 = -\frac{\hbar}{\pi}\int_0^\infty \frac{d_{\mu\alpha}([x-x'],\omega)}{\omega}\,d\omega,$$

where $d_{\mu\alpha}$ is a dissipation tensor. The covariant commutation relations are

$$[A_\mu(x), A_\alpha(x')] = -\frac{\hbar}{\pi}\int_0^\infty \frac{[d_{\mu\alpha}([x-x'],\omega) - d_{\alpha\mu}([x'-x],\omega)]}{\omega}d\omega.$$

A well-defined cut-off procedure is given for calculating observable fluctuations in cases where the theorem gives infinite results. For measurements with a linear device which has energy $E = \hbar\omega_c$, the observable fluctuations of the vacuum electromagnetic fields are given by the exact expression

$$\langle V^2\rangle = -\frac{\hbar}{\pi}\int_0^{\omega_c} R(\omega)\omega d\omega.$$

A.

530.145

4182. PROBLEMS IN THE QUANTUM THEORY OF THE FIELD. N.N.Bogolyubov and D.V.Shirkov.
Uspekhi fiz. Nauk, Vol. 57, No. 1, 3-92 (1955). In Russian.

This is the second half of a survey paper on the above topic (see Abstr. 902/1956), and is concerned mainly with the elimination of divergences from the scattering matrix. Topics discussed are:- spinor electrodynamics in 2nd and 3rd order, general rules for eliminating divergences from an S-matrix, general form of contra-terms, mass and charge in spinor electrodynamics. 22 refs. C.R.S.Manders

530.145

4183. ON "POTENTIALS" IN THE THEORY OF QUANTIZED FIELDS. W.Królikowski.
Nuovo Cimento (Ser. 10), Vol. 3, No. 2, 260-75 (Feb., 1956).

In the first part of this paper the problem of deriving the equations for the state vector of N_0 particles from the Schrödinger equation corresponding to a system of interacting fields is discussed. An inhomogeneous integro-differential equation is obtained in which the inhomogeneity is determined by the initial value of the state vector corresponding to N particles ($N \neq N_0$). In the case when this vector vanishes at a particular time, the equation for the state vector of N_0 particles becomes homogeneous and may be replaced by a stationary equation independent of the time and containing an interaction operator which is a function of the energy eigenvalue (non-linear energy eigenvalue problem). A closed expression is obtained for the kernel of the integro-differential equation, valid for arbitrary values of the interaction constant. In the second part the integro-differential equation for the state vector of N_0 particles is replaced by an equivalent purely differential equation with respect to the time. In the homogeneous case this equation has the form of a Schrödinger equation (linear energy-eigenvalue problem) with a complex "potential". The imaginary part of this potential is due to the instability of the state of N_0 particles and determines the life-time of this state. It is suggested that this equation describes — after time separation — the bound states of N_0 particles. A.

530.145

4184. CURRENT DENSITY IN QUANTUM ELECTRODYNAMICS. M.Cini and S.Fubini.
Nuovo Cimento (Ser. 10), Vol. 2, No. 4, 860-3 (Oct., 1955).

The authors' non-linear operator equation for the current density j(x) (Abstr. 7696-7/1955) is derived using the Heisenberg representation from the beginning. Furthermore, it is pointed out how a complete determination of j(x) may be possible in quantum electrodynamics. W.A.Hepner

530.145

4185. A SIMPLE NON-LOCAL QUANTUM ELECTRODYNAMICS. P.Sen.
Nuovo Cimento (Ser. 10), Vol. 3, No. 2, 390-408 (Feb., 1956).

The Dirac—Maxwell equations are modified, according to Wataghin, by displacing the fields at the point of their interaction by introducing displacement parameters. When these parameters, which are taken to be small, tend to zero the original Dirac—Maxwell equations are obtained. The original charge renormalization programme, the theory of Feynman (cut-off) and Yukawa's non-local theory of particles with internal structure and the consequent convergent quantum electrodynamics can be considered as special cases of these modified Dirac—Maxwell equations. By combining the methods of these processes a convergent quantum electrodynamics, in which the original Feynman graph integrals are modified by the multiplication of a simple modifying factor, is obtained. This is illustrated by the calculations of second-order Feynman graphs. It is then suggested that these equations can be considered to be free from the need of charge renormalization and the actual charge renormalization is due to the use of the Born approximation. A.

530.145

4186. COVARIANT CANONICAL EQUATIONS FOR A CLASSICAL FIELD. I. R.S.Liotta.
Nuovo Cimento (Ser. 10), Vol. 3, No. 2, 438-46 (Feb., 1956).

Hamilton's equations are written for a classical field by using the momenta conjugate to the field variables, with respect to all the directions of the time space frame of reference. The Hamiltonian function becomes the spur of the canonical tensor and the equations become covariant ones. One can write Jacobi's equations in an invariant form and it can be shown that Jacobi's function is to be considered as the generator of a canonical transformation. With the introduction of convenient functionals one can study the evolution of the system when a certain space-like surface is made to vary. A.

530.145

4187. A NEW METHOD OF REMOVING SELF-ENERGY DIVERGENCIES IN QUANTUM ELECTRODYNAMICS. O.v.Roos.
Z. Phys., Vol. 144, No. 4, 323-35 (1956). In German.

The divergencies of the e^2-terms in the transversal and longitudinal self-energy of the electron are removed with the help of a form factor $F(k.x_1 + x_2)$ in the Fourier representation of the commutator function $D(x_1, x_2)$. Using the multiple time formalism and the Tamm—Dancoff method, the first approximation of the Bethe—Salpeter equation is derived. W.A.Hepner

530.145

4188. COMPTON SCATTERING AND BREMSSTRAHLUNG OF SPIN-3/2 PARTICLES. J.Mathews.
Phys. Rev., Vol. 102, No. 1, 270-4 (April 1, 1956).

The Fierz-Pauli theory of particles of spin $\frac{3}{2}$ in interaction with the electromagnetic field is used to calculate the cross-section in Born approximation for Compton scattering by such particles. The bremsstrahlung cross-section is estimated by the method of virtual quanta. The magnitude of these cross-sections rules out the possibility that the μ-meson is such a particle. A.

530.145

4189. REPRESENTATION OF ROTATIONS IN THREE-SPACE BY COMPLEX 2 x 2 MATRICES. M.J.Walker.
Amer. J. Phys., Vol. 24, No. 4, 205-8 (April 1956).

A comparison is made between the representation of rotations in three-dimensional space by real 3 x 3 matrices and complex 2 x 2 matrices. The relationship is used as a means of visualizing first-rank spinors. A.

530.145

4190. ON THE THEORY OF ELEMENTARY PARTICLES. II. G.Heber.
Ann. Phys. (Leipzig), Vol. 17, No. 2-3, 102-8 (1956). In German.

The physical implications of the calculations of Pt I (Abstr. 8497/1955) are considered. They are found to be incompatible with the usual canonical quantization.

W.A.Hepner

530.145

4191. SUPPLEMENTARY REMARK ON MY PREVIOUS NOTE "VELOCITY OF THE DIRAC ELECTRON". Z.Koba.
Nuovo Cimento (Ser. 10), Vol. 3, No. 1, 214-15 (Jan., 1956).

See Abstr. 3483 (1956). Further consideration is given to the behaviour of the relativistic wave packet during two successive ideal determinations of the x coordinate of the electron. It is concluded that the measurements would lead to an eigenstate of the x component velocity operator if the time interval between the measurements were much smaller than the reciprocal Compton frequency. R.A.Newing

530.145

4192. HYDRODYNAMICAL DESCRIPTION OF THE DIRAC EQUATION. T.Takabayasi.
Nuovo Cimento (Ser. 10), Vol. 3, No. 2, 233-41 (Feb., 1956).

By suppressing Ψ-spinor and γ-matrices completely, the Dirac field is shown to be equivalent with a non-linear vector field, which is fully interpreted as defining a new kind of relativistic hydrodynamics of a spinning fluid. In this hydrodynamics, there appears, besides spin, an additional internal degree of freedom θ, which specifies the disparatenesses between rest charge density and proper mass density and also between velocity and momentum. The theory is described for the case of Dirac field under the action of Maxwell field, manifesting also the gauge-independent feature of the formulation. A.

530.145

4193. NEW CLASSICAL SPIN THEORY AS THE LIMIT OF THE DIRAC EQUATION. T.Takabayasi.
Nuovo Cimento (Ser. 10), Vol. 3, No. 2, 242-5 (Feb., 1956).

By taking the classical limit in the tensor formulation of the Dirac equation (see preceding abstract) a new classical relativistic spin theory is obtained, which is different from the one due to Kramers, coinciding with it only in non-relativistic approximation substantially. The theory yields the classical limit for Dirac particle, which is different from that due to Pauli. A.

530.145

4194. PROPERTIES OF HALF-INTEGRAL SPIN DIRAC–FIERZ–PAULI PARTICLES. P.A.Moldauer and K.M.Case.
Phys. Rev., Vol. 102, No. 1, 279-85 (April 1, 1956).

A method is developed to eliminate extraneous components from the Dirac–Fierz–Pauli equations for half-integral spin particles. Starting from the Rarita–Schwinger formulation, Hamiltonian forms of the equations for the independent components of the wave-functions are obtained. The process is carried out in detail for the field-free spin 3/2 and spin 5/2 particles and the reduced equations are quantized. It is shown that the interaction with the electromagnetic field can be introduced in an infinite variety of ways. A one-parameter class of equations containing the interaction is obtained for each spin. By reducing these equations in the nonrelativistic limit it is shown that the gyromagnetic ratio is in each case independent of the parameter and has the unique value of the reciprocal of the spin. For the cases of spin 3/2 and spin 5/2, the quadrupol moment is also obtained. It has the unique value + (5/3) (ħ/mc) for spin 3/2. For spin 5/2, it depends on the parameter but is close to + $(28/15)(\hbar/mc)^2$ over most of its range. A.

530.145

4195. SYNTHESIS OF COVARIANT PARTICLE EQUATIONS L.L.Foldy.
Phys. Rev., Vol. 102, No. 2, 568-81 (April 15, 1956).

By combining two irreducible representations of the prope inhomogeneous Lorentz group, certain irreducible unitary representations of the complete Lorentz group including space and time inversion are obtained, together with a Schrödinger equation whose solutions constitute the representation space for these representations. The representations thus define a 'canonical' form for covariant particle theories, in which not only the wave equations but the manner in which the wave functions transform under Lorentz transformations is prescribed. It is shown that by a suitable choice of representation, the Dirac, Klein–Gordon and Proca equations can all be reduced to this canonical form. It is further shown that in the representation space provided, several possibilities exist for the identification of the transformations to be associated with space inversion, time inversion, and charge conjugation, thus suggesting the existence of several distinct relativistic theories for particles of any given spin. Conjectures are made as to the physical significance of these different possibilities when the equations are second-quantized. It is shown that each of the conventional theories employs only one of the available possibilities for these transformations, the choices being different for integral and half-integral spin theories. A

530.145

4196. ON THE JAUCH FIELD. S.Kamefuchi and S.Tanaka.
Progr. theor. Phys., Vol. 13, No. 3, 334-6 (March, 1955).

The free field Lagrangian and energy-momentum corresponding to Jauch's suggestion for spinor field quantization are found to be essentially equivalent to those of the usual Dirac field, while the interacting field reduces to a Dirac field with generalized interactions. Contrary to Jauch's result, it is stated that there are four possible transformation types under space reflection and time reversal. W.A.Hepner

530.145

4197. CLASSICAL MESON THEORY. I. S.Kahana and H.R.Coish.
Amer. J. Phys., Vol. 24, No. 4, 225-39 (April, 1956).

Meson field theory is introduced from an elementary point of view in analogy with familiar classical fields. Three formulations are considered: scalar, pseudoscalar, and vector. In the symmetric theory the isotopic spin of a nucleon is taken to be a classical vector in charge space. A.

530.14

4198. CLASSICAL MESON THEORY. II. S.Kahana and H.R.Coish.
Amer. J. Phys., Vol. 24, No. 5, 390-9 (May, 1956).

The theory is applied to nuclear forces, the deuteron, meson scattering, and photoproduction. A

530.14

4199. THE DETERMINATION OF THE SCATTERING POTENTIAL FROM THE SPECTRAL MEASURE FUNCTION. III. CALCULATION OF THE SCATTERING POTENTIAL FROM THE SCATTERING OPERATOR FOR THE ONE-DIMENSIONAL SCHRÖDINGER EQUATION. I.Kay and H.E.Moses.
Nuovo Cimento (Ser. 10), Vol. 3, No. 2, 276-304 (Feb., 1956

For Pt II, see Abstr. 3493 (1956). A procedure discussed in

previous papers for the calculation of the scattering potentials from the spectral measure functions associated with certain eigenfunctions of the continuous spectrum of the perturbed Hamiltonian, has been adapted to the problem of obtaining the scattering potential from the scattering operator for the one-dimensional Schrödinger equation ($-\infty < x < \infty$). Examples are given to show how the procedure may be used. A.

530.145

4200. N–V POTENTIAL IN THE LEE MODEL. S.Weinberg.
Phys. Rev., Vol. 102, No. 1, 285-9 (April 1, 1956).

An investigation is made of states in the Lee model representing a 'physical' V-particle bound to an N-particle. It is found that the energy eigenvalue problem can be reduced to a single transcendental equation involving the parity, energy, renormalized coupling, and N–V separation. Only states of odd parity are considered. For such states this equation leads to a single-valued real potential if the renormalized coupling constant < the critical value for the appearance of the so-called 'ghost' states of the free physical V-particle. For stronger couplings the potential becomes many-valued with half its real branches corresponding to the presence of 'normal' V's, and half to 'ghost' V's. For still stronger coupling no real energies exist. It is shown that complex energies appear, at least in the case where the virtual θ particles are assumed nonrelativistic and the N–V separation is sufficiently small. A possible reason for the appearance of these difficulties is suggested. A.

530.145

4201. DIFFERENTIAL INELASTIC SCATTERING OF RELATIVISTIC CHARGED PARTICLES. U.Fano.
Phys. Rev., Vol. 102, No. 2, 385-7 (April 15, 1956).

The angular distribution of inelastic scattering, given by the Møller–Bethe formulae, is presented explicitly and analysed in terms of longitudinal and transverse interactions which are incoherent because of different parity. Its connection with the Cherenkov radiation and its conceivable experimental observation are indicated. A.

530.145

4202. HIGH-ENERGY ELECTRON–NUCLEAR SCATTERING. H.Mendlowitz.
Phys. Rev., Vol. 102, No. 2, 527-9 (April 15, 1956).

The Hamiltonian of a Dirac electron is transformed to a representation in which an expansion in inverse powers of the kinetic energy is facilitated. The approximation of Yennie, Ravenhall, and Wilson is readily obtained and correction terms of order $(m/p)^2$ indicated. At lower energies, it is shown that the scattering gives the gross aspects rather than the details of the charge distribution, as is well known. Effects of the spin-dependent terms in the interaction are discussed. A.

530.145

4203. INTERPRETATION OF THE PHASE SHIFTS IN PION-NUCLEON SCATTERING. R.G.Sachs.
Phys. Rev., Vol. 102, No. 3, 867-70 (May 1, 1956).

Wigner has shown that there is a lower limit on the derivative of the scattering phase-shift with respect to energy, the limit being expressed in terms of the range of the interaction. Orear has pointed out that this condition is not satisfied by the pion-nucleon S-wave phase shifts given by Bethe and de Hoffmann for energies near 200 MeV. Orear's alternate solution, satisfying Wigner's criterion, fits the data equally well. The use of the Wigner condition for pion-nucleon scattering is somewhat questionable because the concept of interaction radius is not well defined. It is shown here that a similar condition may be obtained without the use of this concept. Orear's argument is strengthened on this basis. A simple interpretation of the S-wave phase-shifts is given in terms of an $I = \frac{1}{2}$ resonance at very high energy, the only parameter being the ratio of level width to resonance energy. A simple two-parameter interpretation of the P-wave phase is also presented. A.

530.145

4204. NUCLEON–NUCLEON SCATTERING. H.Feshbach and E.Lomon.
Phys. Rev., Vol. 102, No. 3, 891-904 (May 1, 1956).

Nucleon–nucleon scattering data from 0 to 274 MeV are discussed by means of a boundary-condition approximation. For internucleon distances greater than the core radius, which may depend on the state under discussion, the nucleon–nucleon interaction is assumed to vanish, while at the core radius the logarithmic derivative of the wave-function or the reaction matrix satisfies a boundary condition. Assuming charge independence, it has been found possible to fit most of the experimental data with all but one boundary condition energy-independent. The core radius for the $^1S_0$ state is assumed to decrease with increasing energy. It is found that p-p scattering is composed mostly of scattering in the $^1S_0$ and $^3S_0$ states, both of which give isotropic distributions. The scattering from the $^3P_0$ state is close to the scattering by a repulsive sphere of radius 1.32×10^{-13} cm. The scattering in the isotopic singlet state below 100 MeV, assuming that the n-p angular distribution is symmetric about 90^0, is entirely determined by the low-energy fit to triplet ($^3S_1 + {}^3D_1$) n-p scattering. Above 100 MeV the ($^3S_1 + {}^3D_1$) states make the major contribution to the isotopic singlet scattering. The predicted cross-sections fail significantly in only one detail: they are not sufficiently large for n-p scattering near 180^0. Regardless of the validity of this particular fit, the boundary-condition approximation is found to provide a comparatively simple method for the broad correlation and understanding of the experimental results. A.

530.145

4205. NUCLEON SCATTERING AND THE FESHBACH–LOMON MODEL. R.B.Raphael.
Phys. Rev., Vol. 102, No. 3, 905-13 (May 1, 1956).

A method, based upon the results of Feshbach and Lomon, is established by which a given potential may be simply tested for its capability of providing an adequate charge-independent description of nucleon–nucleon scattering to 300 MeV. The view is taken that the scattering is better represented by replacing the (in general) strongly energy-dependent scattering phase-shifts with a set of suitably defined logarithmic derivatives Γ_{JL}. These, when evaluated at a "characteristic interaction distance" $\bar{r}$, will depend at most weakly upon energy. The success of the Feshbach–Lomon (FL) model in the interval 0 to 300 MeV is here regarded more generally as establishing this view in the above energy range. These ideas are given their mathematical formulation through a generalization of effective-range methods familiar in low-energy scattering. Here $\bar{r}$, which plays the role of an effective range, is shown by means of stationary expressions for Γ_{JL} to attain a state-independent value equal to the FL "core" radius, provided that Γ_{JL} has the desired weak energy dependence. It is then only necessary to find the behaviour with energy of the parameters Γ_{JL}, as determined by a given potential, in order to test whether or not the latter is capable of giving a charge-independent description of the scattering. The method is illustrated in singlet S-states with two-parameter monotonic static potentials. It is found that Gaussian, exponential, and Yukawa potentials are not consistent with the analysis unless these potentials also contain a repulsive core whose radius is suitably restricted. A rectangular potential is barely possible because of the uncertainties in the FL fit arising from insufficient experimental data. An Appendix is devoted to a discussion of the variational principle used in the text. A.

530.145

4206. A REMARK ON THE INTERACTION OF THE SECOND KIND. T.Yoshimura.
Progr. theor. Phys., Vol. 13, No. 3, 336-8 (March, 1955).

Avoiding perturbation methods, it is argued that, within the canonical formalism, the difficulties of explaining multiple productions at high energy with the help of unrenormalizable interactions of the second kind are greater than with interactions of the first kind. W.A.Hepner

530.145

4207. RECOIL EFFECT AND SPIN-ORBIT COUPLING. S.Sato.
Progr. theor. Phys., Vol. 13, No. 4, 457 (April, 1955).

The method of Fukuda, Sawada and Tekatini (Abstr. 1504/1955) is used to derive the velocity-dependent terms in the nucleon–nucleon potential due to ps mesons with pv coupling. The resulting spin-orbit potential is consistent with the spin-orbit coupling in the shell model. P.T.Matthews

530.145 : 539.18

4208. INTRODUCTION TO SOME RECENT WORK IN MESON THEORY. G.C.Wick.
Rev. mod. Phys., Vol. 27, No. 4 (I), 339-62 (Oct., 1955).

A good introduction to the present developments such as Chew's theory and the Chew–Low theory. The treatment avoids formal questions and is aimed at readers who are familiar only with non-relativistic quantum mechanics and its application to scattering. G.E.Brown

530.145

4209. SURVEY OF THE INTERPRETATIONS OF QUANTUM MECHANICS. M.Bunge.
Amer. J. Phys., Vol. 24, No. 4, 272-86 (April, 1956).

A survey is made of the hitherto proposed answers to the following crucial questions arising in the physical interpretation of the mathematical formalism of wave mechanics: (I) What is the meaning of the dynamical variables and of their eigenvalues? (II) What is the meaning of the wave function? (III) What is the nature and origin of Heisenberg's uncertainty relations? (IV) What is the nature of the systems dealt with by wave mechanics? Taking into account the interpretations that have been proposed in the last few years, a surprisingly large number of answers is found. The present situation in quantum mechanics is compared with similar crises in the past history of physics. The mere multiplicity of consistent interpretations of quantum mechanics is regarded as a warning against the dogmatic adherence to any one of them, to the exclusion of new possibilities. A.

530.145

4210. APPLICATION TO WAVE MECHANICS OF A NEW TRANSFORMATION IN SPECIAL RELATIVITY. R.Reulos.
C.R. Acad. Sci. (Paris), Vol. 241, No. 24, 1723-6 (Dec. 14, 1955). In French.

Transformations used in the author's theory of corpuscles (Abstr. 2645/1956) are discussed, and the relation of the author's wave equation $i\hbar\partial\Psi_r/\partial x_k = P_k\Psi_r$ to other wave equations is considered. R.A.Newing

530.145

4211. ON THE H-THEOREM IN QUANTUM MECHANICS. R.Jancel.
C.R. Acad. Sci. (Paris), Vol. 242, No. 10, 1268-70 (March 5, 1956). In French.

Using von Neumann's concept of a macroscopic observable and an inequality due to O. Klein, it is shown that H decreases with time. This result is valid only for a time interval of restricted duration. P.T.Landsberg

530.145

4212. INGOING WAVES IN THE FINAL STATE OF IONIZATION PROBLEMS. S.Altshuler.
Nuovo Cimento (Ser. 10), Vol. 3, No. 2, 246-51 (Feb., 1956).

The ionization problem is re-formulated to show how the ingoing wave modification of final states may be directly deduced. The analysis is general and includes interactions which are explicitly time dependent. A.

530.145

4213. TRANSFER OF NUCLEAR PARTICLES. G.Breit.
Phys. Rev., Vol. 102, No. 2, 549-56 (April 15, 1956).

The calculation of the wave function of a particle subjected to the field of two isolated potential wells is arranged in such a way as to bring into evidence the penetration factors for passage through regions of negative kinetic energy between the wells. The Schrödinger equation is replaced by an equivalent integral equation and the eigenfunction system of the latter is used for the expansion of the wave function. The dependence of the kernel on energy and the transformation from the reference system of the integral equation to that of the wave equation are considered. Extensions to three-dimensional problems and to many nuclear particles are discussed and some characteristic differences from the one-dimensional case are pointed out. The presence of more than one tunnelling factor in the general case and the participation of tongues or tentacles in configuration space which correspond to the temporary formation of nuclear aggregates such as deuterons or alpha particles are considered. A.

530.145

4214. EXPANSION IN ANGULAR MOMENTA IN BOUND-STATE PERTURBATION THEORY. G.E.Brown and G.W.Schaefer.
Proc. Roy. Soc. A, Vol. 233, 527-36 (Jan. 10, 1956).

An expansion of the propagator $S_F^{(V)}(x_2, x_1)$ of a relativistic electron in a central static potential is given. The terms of this expansion correspond to the angular momenta of the electron propagated by this function. Applications to problems concerning heavy atoms are indicated. A.

530.145

4215. THE RELATION BETWEEN THE WENTZEL–KRAMERS–BRILLOUIN AND THE THOMAS–FERMI APPROXIMATIONS. N.H.March and J.S.Plaskett.
Proc. Roy. Soc. A, Vol. 235, 419-31 (May 8, 1956).

It is shown that two essential approximations are made in using the customary Thomas–Fermi formula for the sum of the eigenvalues in any one-dimensional problem. The first is to start from the Wentzel–Kramers–Brillouin formula for the individual eigenvalues, and the second is to replace the summation by an integration. The three-dimensional central field problem is then considered, and by similar arguments, though with an additional approximation, the usual Thomas–Fermi energy formula is again obtained. Possible ways of correcting the errors introduced by integrating instead of summing are discussed and illustrative examples given. In the three-dimensional case particular attention is given to the Coulomb field problem. Finally, brief reference is made to the possibility of correcting for the errors of the Wentzel–Kramers–Brillouin formula. A.

530.145

4216. SIMPLIFICATION IN FINDING SYMMETRY-ADAPTED EIGENFUNCTIONS. M.A.Melvin.
Rev. mod. Phys., Vol. 28, No. 1, 18-44 (Jan., 1956).

The problem of finding symmetry-adapted functions (SAF's) belonging to irreducible representations of a group (R) is examined. The problem arises when one wishes to determine the states of a complex system in terms of combinations of functions given by some simplified problem (as in the determination of molecular symmetry coordinates, or approximate molecular, atomic or nuclear eigenstates). A standard method for finding SAF's is to project any given function with respect to each row of each representation; the projection operator is the sum of operations of (R) each weighted by an element of the corresponding representation matrix. It is shown here that each projection operator can be written simply as a product of two factors: (1) the sum of operations in the identity-mapping or kernel subgroup (K) and (2) a weighted sum of operations in a quotient set of (K). The kernel operator (1) and its quotient operator (2) may often be factored again and the simplification carried on to a reduction to two-term factors, whereupon the testing of a function for its potency to contribute an SAF becomes especially simple. Kernel operators are interpreted intuitively by the symmetry principle. Several examples illus-

rating the application of the tables of factored projection perators are given. An auxiliary simplification occurs with egenerate representations in which the principal diagonals anish in a set of the matrices just suitable to reduce the rocess to one for a subgroup (devertebrate simplification). he structures of all the point symmetry groups are analysed, nd tables of factored and simplified projection operators for ll irreducible representations are given (except for the icosa- edral and spherical groups). All of the dihedral-type groups, ne tetrahedral group $\mathcal{T}$, and the didodecahedral group $\mathcal{T}^h$, espectively, admit of devertebrate simplification. A.

530.145

4217. QUANTUM MECHANICS AS DIFFRACTION PHENOMENON OF GUIDING WAVES. III. MAXWELL RADIATION THEORY AND SCHRÖDINGER WAVE MECHANICS AS DEGENERATE CASES. NUCLEAR PHYSICS AND EXPERIMENTAL TEST OF THE NEW THEORY. R.Hosemann and S.N.Bagchi. Z. Phys., Vol. 142, No. 4, 363-79 (1955). In German.

For Pt II, see Abstr. 928(1956). The discussion of special ases of the general non-linear wave equation is continued. or photons the equations for "Fresnel" regions ($\Box a < 0$) liffer from those for "Fraunhofer" regions ($\Box a \sim 0$). In the ormer regions the corpuscular velocity is less than c, and est mass differs from zero. The different behaviour of hotons in the two regions may lead to observational tests f the theory. The Schrödinger wave equation is valid when $|\Box a| \ll a(m_0c/\hbar)^2$, but ceases to be valid when $|\Box a| >$ about $(m_0c/\hbar)^2$ as is the case for nuclear physics, and account nust then be taken of the non-linear character of the funda- nental wave equation. The possibility of observational tests rovided by phenomena beyond the range of validity of the chrödinger equation is discussed. R.A.Newing

530.145 : 621.385.1.029.6

4218. INTERACTION BETWEEN ELECTRONS AND WAVES. .Brillouin.
roc. Nat. Acad. Sci. U.S.A., Vol. 41, No. 6, 401-15 (June, 955).

The problem is considered from the point of view of wave echanics and appears as a generalization of the Mathieu equa- ion. An electric line coupled to an electronic beam is used as model, as in the classical treatment (Abstr. 1123 B/1950; . appl. Phys., Vol. 20, 1196-205, Dec., 1949). The classical aw of motion of the electron is replaced by a Schrödinger equ- tion. The dispersion formula is derived for the case of weak oupling and a complete physical interpretation is given. A eneral solution can be obtained also for the case of strong oupling. However the reaction on the electromagnetic wave is nuch more complicated in this case and its treatment would equire the obtainment of a self-consistent field. Applications re discussed. L.Pincherle

530.161 : 530.145

4219. IRREVERSIBILITY AND QUANTUM THEORY. H.Kümmel.
Z. Naturforsch., Vol. 11a, No. 1, 15-20 (Jan., 1956). In German.

The irreversible approach to equilibrium is interpreted as a quantum theoretical effect, provided that a coarse-grained robability description of the system is justifiable.
P.T.Landsberg

530.162 : 533.7

4220. THE STATISTICAL MECHANICAL THEORY OF TRANSPORT PROCESSES. IX. CONTRIBUTION TO THE THEORY OF BROWNIAN MOTION. J.Ross.
. chem. Phys., Vol. 24, No. 2, 375-80 (Feb., 1956).

For Pt VIII see Abstr. 9983 (1954). The equations of rownian motion are derived from Liouville's equation in a reatment which parallels Kirkwood's statistical mechanical nalysis but which is based upon the theory of phase space ransformation functions. The transformation function obeys iouville's equation and thus expresses the equations of motion; it is obtained as a solution of that equation by a consistent method of successive approximations which treats the forces as perturbations. Retention of first-order terms only in this solution leads to the Chandrasekhar equation and yields a tractable relation between the friction constant and the intermolecular forces. The restrictions imposed by the present derivation on the molecular interpretation of the equations of Brownian motion are discussed. A.

GENERAL MECHANICS. MECHANICS OF SOLIDS 531

531.258

4221. ON THE SOLUTION OF THE PROBLEM CONCERNING A SEMI-INFINITE SOLID SUPPORTING A LOAD DISTRIBUTED ALONG A STRAIGHT LINE IN THE BOUNDING PLANE. A.Kammerer.
C.R. Acad. Sci. (Paris), Vol. 242, No. 8, 988-91 (Feb. 20, 1956). In French.

The classical solution of Boussinesq and Flamant for the two-dimensional stress and displacement distributions caused by a normal load involves only one arbitrary constant and is incomplete (see Abstr. 6086/1952). A solution involving an infinite number of arbitrary constants is given, which permits more general distant boundary conditions to be satisfied.
J.G.Oldroyd

531.383 : 539.622

4222. THE TIPPE TOP AGAIN. I.M.Freeman.
Amer. J. Phys., Vol. 24, No. 3, 178 (March, 1956).

By consideration of the changes in direction of the angular momentum vector, a simpler explanation than Del Campo's (Abstr. 2704/1956) is given to show that the torque produced by friction is in the correct direction for the observed motion of the top. S.Weintroub

531.57

4223. APPLICATION OF THE ENGRAVEMENT METHOD TO THE STUDY OF PARTICLE VELOCITY DISTRIBUTION IN EXPLOSIVELY LOADED CYLINDERS. J.Pearson and J.S.Rinehart.
J. appl. Phys., Vol. 26, No. 12, 1431-5 (Dec., 1955).

Application of the engravement method to the study of particle velocity distribution in the wall of a thick-walled metal cylinder internally loaded with an explosive charge is described. Tests were conducted with this method on modified cylinders of annealed low-carbon steel and of brass. Even though each of the modified cylinders broke into a number of fragments, the engravements were well enough preserved to furnish considerable data. Many measurements were obtained from each cylinder by using a large number of pellets of several thicknesses. Particle velocity data were obtained to within $\frac{7}{16}$ inch from the metal-explosive interface. Temporal particle velocity distribution curves are presented for each of the cylinders. A.

MECHANICAL MEASUREMENTS 531.7

531.76 : 621.317.79

4224. ELECTRONIC DEVICE FOR MEASURING RECIPROCAL TIME INTERVALS. E.F.MacNichol, Jr and J.A.H.Jacobs.
Rev. sci. Instrum., Vol. 26, No. 12, 1176-80 (Dec., 1955).

A device is described which converts a train of electrical impulses into a succession of hyperbolic wave-forms of amplitude proportional to the interval between successive impulses. These wave-forms when applied to an oscilloscope furnish a display capable of showing rapid changes in the frequency of an electrical signal. Unlike conventional counting-rate, response to sudden changes in frequency is immediate so that averaging

over several cycles is not required. The instrument as constructed operates in the lower audio-frequency range and is being used in the study of the electrical discharge of single fibres of the optic nerve. A.

531.761 : 621.317.79

4225. CONTINUOUSLY VARIABLE MERCURY DELAY LINE EQUIPMENT FOR THE MEASUREMENT OF SHORT TIME INTERVALS. C.Sheer, A.Zinn and N.Hartmann.
Rev. sci. Instrum., Vol. 26, No. 10, 942-5 (Oct., 1955).

Describes an equipment for the precision measurement of short time intervals as defined by two successive electrical pulses. It features two identically constructed mercury ultrasonic delay lines, one in each of two channels. These lines are precision-built and extensible in length by approximately 10%. The measurement is made by first adjusting the lines for equal delay, feeding the pulses into the two channels, respectively, and then noting the extension of the line receiving the prior pulse which is required to bring the two output pulses into coincidence. A continuous range of measurement of 0 to 40 μsec is available, and the upper limit can be extended as desired by inserting fixed delays in one channel externally. Apart from the continuously variable feature, the instrument is characterized by relatively high precision, ease of measurement, versatility, and reliability. A.

MECHANICS OF FLUIDS 532

532.13 : 532.77 : 541.64

4226. SAKURADA EQUATION FOR THE INTRINSIC VISCOSITIES OF POLYMER SOLUTIONS. V.V.Varadaiah and M.Ramakrishna Rao.
Curr. Sci., Vol. 24, No. 9, 296-7 (Sept., 1955).

Viscosity data obtained from light scattering behaviour on some solutions of polymethyl methacrylate, polystyrene and polyvinyl acetate support Sakurada's equation. See Chemistry of High Polymers (Japan) 2, 253, 1945. T.C.Toye

532.133 : 541.64

4227. GRADIENT DEPENDENCE OF THE INTRINSIC VISCOSITY OF LINEAR MACROMOLECULES. A.Peterlin and M.Čopič.
J. appl. Phys., Vol. 27, No. 5, 434-9 (May, 1956).

The decrease of intrinsic viscosity with increasing gradient was found with all linear macromolecules investigated at high enough molecular weight irrespective of the solvent. But experiments do not agree on the power of the gradient to which the deviations from the zero value are proportional. Exponents $\frac{1}{2}$, 1, and 2 have been proposed to fit experimental data. The necklace model with hydrodynamic interaction yields suitable gradient dependence of the intrinsic viscosity only if either the molecule has a nonvanishing rigidity or the anistropy of the hydrodynamic interaction is explicitly considered. Since the first effect decreases with increasing M, very likely most of the observed gradient dependence has to be attributed to the second one which is intrinsically connected with the statistical shape of the molecular coil and the character of the hydrodynamic forces. A.

532.5 : 538.56

A DISCUSSION ON MAGNETO-HYDRODYNAMICS. See Abstr. 3845

532.51

4228. A CLASS OF SOLUTIONS OF THE EQUATIONS OF MOTION OF A HEAVY LIQUID WITH A FREE SURFACE. R.Gerber.
C.R. Acad. Sci. (Paris), Vol. 242, No. 10, 1260-2 (March 5, 1956). In French.

In a previous paper (Journal de Mathématiques Pures et Appliqués, Vol. 34, 185-299, 1955), the author has establish an existence theorem relating to solutions of the equations of motion of a heavy liquid with a free surface satisfying the condition $U(\phi, \psi_0) \leq 0$. The existence of solutions of the equati there discussed is now established for the condition $U(\phi, \psi_0) \geq$ The existence theorem is established by the introduction of an auxiliary equation. J.S.G.Thomas

532.517.

4229. THE FINAL PERIOD OF DECAY OF NON-HOMOGENEOUS TURBULENCE. O.M.Phillips.
Proc. Cambridge Phil. Soc., Vol. 52, Pt 1, 135-51 (1956).

A study is made of the properties of the motion due to a general localized disturbance in an infinite fluid initially at rest. Two invariants of the motion are found, which are identi fied with the net linear momentum, or effective dipole strengt and the net angular momentum imparted to the fluid, and an equation is derived expressing the rate of change of the effective quadrupole strength of the motion. Solutions are obtained for the final period of decay of such a motion, and it is shown that, when the net linear momentum of the fluid is non-zero, the motion corresponds to a type of viscous vortex ring. The length scale increases with time t as $[\nu(t-t_0)]^{1/2}$, and the total energy decays as $[\nu(t-t_0)]^{-3/2}$, where ν is the kinematic viscosity and t_0 is a virtual time origin. If the net momentum is zero, the total energy decays as $[\nu(t-t_0)]^{-5/2}$, and expressions are given for the velocity field in this case also. It is shown that, if it is attained, the final period of any turbulent motion can be found from the vortex ring type of solution described above. The final period of homogeneous turbulence is clearly one particular example of such a motion. The final period of a axially symmetrical turbulent wake is treated in this way and is shown to consist generally of the superposition of two types of motion: (i) a mean streaming motion whose energy per unit length of the wake decreases as $[\nu(t-t_0)]^{-1}$, and (ii) a superimposed fluctuating motion whose energy per unit length decays as $[\nu(t-t_0)]^{-5/2}$. Expressions are given for the distribution of mean-square vorticity and the energy spectrum tensor in the wake. A

532.5

4230. FLUID FLOW IN REGIONS BOUNDED BY POROUS SURFACES. G.Taylor.
Proc. Roy. Soc. A, Vol. 234, 456-75 (March 6, 1956).

The aerodynamic effects of sucking away boundary layer or blowing air into them through a porous surface have been studied on the assumption that the rate of discharge through the pores is under the control of the experimenter. When all the fluid reaches the field of flow through the pores the pressure at any point in the field depends on the distribution over the porous surface of the flow through it, and the through-flo at any point of it depends on the pressure there. To describe flow of this kind mathematically is difficult and no case seem to have been discussed before. A particular case, that of flo through a wedge, cylinder or cone made of a material the resistance of which is proportional to the square of the velocity through it, is treated by means of an integral equation. This equation is solved and the results reduced to a form wh lends itself to experimental verification. Experiments are de cribed in which the physical conditions assumed in the analy were very nearly attained and the theoretical conclusions the verified. The most striking result was the agreement, to wit in 1%, between the calculated and the measured discharge of water from a tank through an internal porous tube whose bas was an orifice in the bottom. The measured distribution of velocity in the plane of the orifice also agreed with the calcu lations. Experiments with porous cones also yielded results agreeing with theory when the correct experimental conditio could be satisfied.

532.5

4231. UNSTEADY TWO-DIMENSIONAL FLOWS WITH FREE BOUNDARIES. I. GENERAL THEORY. N.Curle.

Proc. Roy. Soc. A, Vol. 235, 375-81 (May 8, 1956).

Gives a summary of relevant earlier work on free-boundary problems and then considers the initial development of steady two-dimensional flows. The motion of an incompressible inviscid fluid with free boundaries is considered by transforming into the hodograph plane $(\ln q_0/U, \theta_0)$ of the steady flow. The equation of the free boundary and the velocity potential are expanded in powers of $e^{-\lambda t}$. Thus

$$\phi(x, y, t) = \phi_0(x, y) + e^{-\lambda t}\, \phi_1(x, y) + \dots ,$$

where ϕ_0 is the known steady-state solution and ϕ_1 is to be determined. The exact boundary condition, which is the unsteady form of Bernoulli's equation, is applied on the free boundary which is not taken as a streamline. A general discussion of the validity of the approach is given. It is foreshadowed that for jet flow through a slit the predicted shape of the jet will probably have a kink at the nose; this is consistent with the assumptions made in the analysis. A.

532.52

4232. UNSTEADY TWO-DIMENSIONAL FLOWS WITH FREE BOUNDARIES. II. THE INCOMPRESSIBLE INVISCID JET. N.Curle.

Proc. Roy. Soc. A, Vol. 235, 382-95 (May 8, 1956).

Considers the flow which results when a slit of finite width is suddenly opened in a large container and a jet of fluid issues into free space. The early stages of the motion are discussed by expanding in powers of time. It is suggested that the jet boundary may be M-shaped initially. The shape of the jet after large but finite time is calculated by the general theory of Pt I to have a kink at the nose. However, by expanding in powers of the distance across the jet, the true radius of curvature of the nose has been evaluated. A realistic shape of the jet is sketched. A.

532.525

4233. EXPERIMENTS ON THE FLOW OF SWIRLING WATER THROUGH A PRESSURE NOZZLE AND AN OPEN TRUMPET. A.M.Binnie and J.D.Teare.

Proc. Roy. Soc. A, Vol. 235, 78-89 (April 10, 1956).

Marked departures from inviscid flow were found when swirling water was discharged downwards under pressure through a Perspex conical nozzle. A boundary layer of forced vortex motion formed on the free surface of the air core, and in this region the loss of total head was large. These results were confirmed by measurements of the tangential and axial velocities close to the free surface. When the supply pressure was low and the swirl great, the axial velocity was reversed in the upper part of the nozzle close to the forced vortex. Similar effects were found in gravity flow through a vertical trumpet. Moreover, outside the forced vortex above the trumpet, the downward flow under some conditions was concentrated in cylindrical zones of small radial thickness. A.

532.528

4234. CAVITATION IN HYDRODYNAMICS.

London: Her Majesty's Stationery Office (1956) 468 pp.

Proceedings of a symposium held at the National Physical Laboratory, September, 1955.

CAPILLARITY 532.6

532.623

4235. INVERTED SOAP BUBBLES — A SURFACE PHENOMENON. N.Skogen.

Amer. J. Phys., Vol. 24, No. 4, 239-41 (April, 1956).

By pouring soap water on to a surface of soap water it is possible to produce thin spherical shells of air in the water (inverted soap bubbles). The largest diameter observed is about 29 mm. Interference colours indicate shell thickness of the order 0.001 mm. Lifetimes of the bubbles of 4-5 minutes have been observed. A connection between the inverted bubbles and drops of water swimming on the surface is pointed out. A.

MOLECULAR THEORY OF LIQUIDS 532.7

532.7

4236. HEXAGONAL DISTANT PACKING OF SYNTHETIC LATEXES. J.F.Hamilton and F.A.Hamm.

J. appl. Phys., Vol. 27, No. 2, 190-1 (Feb., 1956).

The electron micrograph is shown of a shadowed specimen by evaporation of a polymer hydrosol. Alternative explanations are suggested in terms of an interaction energy which is (a) attractive at long distances and repulsive at short, and (b) repulsive even at long distances, the equilibrating force being a compression resulting from surface tension forces as the drop evaporates. S.J.Gregg

532.7 : 536.632

THE RATIO OF SPECIFIC HEATS γ AS A FUNDAMENTAL PHYSICAL PROPERTY OF LIQUIDS. See Abstr. 3533

532.7 : 536.7

4237. MOLECULAR THEORY OF IRREVERSIBLE PROCESSES IN FLUIDS. H.S.Green.

Proc. Phys. Soc. B, Vol. 69, Pt 3, 269-80 (March 1, 1956).

An attempt is made to formulate a theory of irreversible processes in fluids with the same degree of completeness and rigour as the theory of equilibrium based on statistical mechanics. The theory of the grand partition function is generalized to systems not in thermodynamic equilibrium, and to determine the distribution functions an equation is derived which is strictly analogous to Boltzmann's equation in the theory of rare gases. A definition is given of the entropy of a system not in thermodynamic equilibrium, which is more satisfactory than others previously proposed. An H-theorem is proved to establish the natural increase of the entropy so defined. A.

532.72

4238. SELF-DIFFUSION IN LIQUID GALLIUM. J.Petit and N.H.Nachtrieb.

J. chem. Phys., Vol. 24, No. 5, 1027-8 (May, 1956).

Self-diffusion in liquid gallium metal at atmospheric pressure is described by the equation: $D = 1.07 \times 10^{-4} \exp[-1122/RT]\,cm^2\,sec^{-1}$. At 30°C the effect of pressure on the rate of self-diffusion is given by: $\log_{10} D = -4.7793 - 9.529 \times 10^{-6} P$ (kg cm^{-2}). The activation volume at this temperature is 0.55 cm^3 g $atom^{-1}$. Although the Stokes—Einstein radius agrees quite well with the ionic radius of Ga^{+3}, the temperature coefficients of viscosity and diffusivity differ somewhat. A.

532.72 : 532.54

4239. ON THE DISPERSION OF A SOLUTE IN A FLUID FLOWING THROUGH A TUBE. R.Aris.

Proc. Roy. Soc. A, Vol. 235, 67-77 (April 10, 1956).

Taylor has discussed the dispersion of a solute under the simultaneous action of molecular diffusion and variation of the velocity of the solvent (Abstr. 6335, 10856/1954). A new basis for his analysis is presented here which removes the restrictions imposed on some of the parameters at the expense of describing the distribution of solute in terms of its moments in the direction of flow. It is shown that the rate of growth of the variance is proportional to the sum of the molecular diffusion coefficient, D, and the Taylor diffusion coefficient $\kappa a^2 U^2/D$, where U is the mean velocity and a is a dimension characteristic of the cross-section of the tube. An expression for κ is given in the most general case, and it is shown that a finite distribution of solute tends to become normally distributed. A.

532.73 : 536.7

4240. STATISTICAL THERMODYNAMICS OF SOLUTIONS. I.Prigogine, A.Bellemans and A.Englert-Chwoles.
J. chem. Phys., Vol. 24, No. 3, 518-27 (March, 1956).

A new approach to the statistical problem of solutions is presented, which combines the main ideas of the cell method and of the theorem of corresponding states. The basic assumption is that the cell partition function of a molecule in the solution may be formally expressed by the same function as in pure liquid, but with other well-defined values of the reduced temperature and volume. For pure liquids this theory reduces to the usual theorem of corresponding states. The excess properties of the mixture are expressed in terms of molecular parameters related to the interaction energies between pairs of molecules. All the macroscopic coefficients appearing in the excess functions are expressed by experimental properties of the pure compounds, just as in the theory of conformal solutions of Longuet-Higgins. The present model correctly gives the "first-order contributions" to the excess functions like the theory of conformal solutions; it gives also an approximative estimate of the higher order terms. Explicit expressions for the excess functions have been calculated up to the second-order terms. The relations between intermolecular forces and excess functions is discussed in detail for some typical cases. All the conclusions drawn from this model confirm those obtained previously by Prigogine and his collaborators; however the present model permits a much more direct derivation of the main results without the introduction of subsidiary simplifying hypotheses (like simplified cell models). A.

532.77 : 536.423.1

4241. A NOTE ON THE BOILING POINTS OF REGULAR SOLUTIONS. P.K.Katti and O.P.Rustgi.
Curr. Sci., Vol. 24, No. 12, 406-7 (Dec., 1955).

A formula for the boiling-point—concentration curve of binary mixtures is used which depends on effectively four numerical parameters. It is applied to mixtures of benzene and carbon tetrachloride. Values for the parameters are taken from measurements of partial vapour pressures. The calculated curve is in agreement with six values of boiling points obtained by direct measurement. R.Eisenschitz

532.783

4242. BEHAVIOR OF LIQUID-CRYSTAL COMPOUNDS NEAR THE ISOTROPIC-ANISOTROPIC TRANSITION. W.A.Hoyer and A.W.Nolle.
J. chem. Phys., Vol. 24, No. 4, 803-11 (April, 1956).

The compressibility and the specific volume of liquid p-azoxyanisole were studied in the temperature range of the anisotropic-isotropic transition. Both quantities exhibit easily observable pretransitional variations in an interval extending more than two centigrade degrees either side of the transition. The pretransitional behaviour is largely consistent with the Frenkel theory of heterophase fluctuations, provided that an interfacial energy of approximately 0.3 erg/cm^2 between phases is assumed, but the theory apparently does not apply to temperatures very near to the transition. The compressibility measurements were made by an ultrasonic pulsed-signal method, which also yielded the ultrasonic absorption for various frequencies from 0.5 to 6.0 Mc/s. Both the compressibility and the absorption have sharp maxima at the transition. Generally similar ultrasonic results were obtained with cholesteryl benzoate. The frequency dependence of the absorption in p-azoxyanisole corresponds approximately to a two-state compressional reaction with a relaxation time of the order of 10^{-8} sec, which is somewhat greater than the Debye characteristic molecular orientation time for the isotropic phase. Thus the controlling rate mechanism for the absorption is identified tentatively with the orientation time of molecules or of small clusters. The magnitude of the absorption is consistent with a model in which the relaxation effect is associated with the pretransitional increment in the compressibility. A.

533.011.5 : 534.222.2

4243. NOTE ON A FURTHER REGULAR HOMOLOGOUS SOLUTION. W.Häfele.
Z. Naturforsch., Vol. 11a, No. 2, 163 (1956). In German.

A short note. In addition to the three regular homologous solutions already obtained for shock-wave equations of motion (Taylor's, 1940; Guderley's, 1942; the author's, Abstr. 2743/1956), the derivation of a further solution, applicable only to the case of a weak shock-wave front, is briefly explained. J.S.G.Thomas

533.5 : 531.78

4244. A PIRANI GAUGE FOR OPERATION UP TO A PRESSURE OF 10 mm OF MERCURY. J.H.Leck and C.S.Martin.
J. sci. Instrum., Vol. 33, No. 5, 181-3 (May, 1956).

A modified Pirani gauge is described which makes the continuous reading gauge useful in the high pressure range without requiring a great rise in the wire temperature. It is well known that a reduction of the length of the hot wire increases the useful range but at the same time decreases the sensitivity. It is shown here that an adequate sensitivity, combined with a large range, can be obtained by placing artificial supports along the length of the wire so as to give, in effect, a large number of short wires in series. In this way a gauge useful up to a pressure of 10 mm of mercury with a wire temperature of only 50°C, can be designed. A

533.5 : 539.16.08

4245. USE OF KRYPTON-85 IN MEASURING GAS CLEAN-UP RATES. D.J.Harris and P.O.Hawkins.
Nature (London), Vol. 177, 285-6 (Feb. 11, 1956).

The use of this isotope gives information on krypton clean up and also on the relative clean-up rates produced by different discharge conditions. Two techniques are used, (a) radiation from a remote part of the tube is collimated and monitored on a Geiger counter throughout the test, (b) the activity of the valve is measured before and after opening the valve. The residual activity after opening is due to the gas cleaned up on the walls. A.H.W.Beck

533.5 : 669.295 : 621.385.032.94

4246. GETTERING OF GAS BY TITANIUM. V.L.Stout and M.D.Gibbons.
J. appl. Phys., Vol. 26, No. 12, 1488-92 (Dec., 1955).

Titanium metal has been studied as a getter for oxygen, nitrogen, carbon dioxide, air, water vapour, hydrogen, and methane. Titanium above 700°C will getter oxygen, nitrogen, and carbon dioxide. Hydrogen is absorbed by titanium in the temperature range of 25 to 400°C. Water vapour and methane are readily sorbed when the metal is operated at both elevated and reduced temperatures. Large quantities of gases can be sorbed; sorption of 10 - 90 atomic % is possible. When saturated with gas, the metal becomes brittle and is easily fractured. Hydrogen is the only gas which can be released after it has been sorbed by titanium. A

533.6.011.5 : 534.222.2

4247. EXPERIMENTAL STUDIES OF THE INTERACTION OF A PLANE SHOCK WAVE WITH A CIRCULAR CYLINDER. C.-S.Kim and K.Ôshima.
J. Phys. Soc. Japan, Vol. 11, No. 2, 178-80 (Feb., 1956).

Unsteady shock interaction between a plane shock wave and a circular cylinder, considered as a typical body having an intrinsic length, is briefly surveyed. Numerous observations at different times are necessary, since flow patterns in the region of reflection differ from one another. The isopycnics, $\rho_1 \rho_2$ = const., behind the reflected front, and the corresponding interferograms are illustrated. In all cases, value of the density ρ near the cylinder nose was about 7-12% less than

the theoretical value for shock reflection at a rigid plane wall. J.S.G.Thomas

533.6.013.22 : 534.232

4248. ON THE AERODYNAMIC SURFACE SOUND FROM A PLANE TURBULENT BOUNDARY LAYER. O.M.Phillips.
Proc. Roy. Soc. A, Vol. 234, 327-35 (Feb. 21, 1956).

When a fluid in irregular or turbulent motion moves across the surface of a rigid body, dipole sound radiation can be produced by the fluctuating stress distribution set up at the boundary. This radiation, generated by the interaction of fluid in motion with rigid surfaces, can be called aerodynamic surface sound. It is the purpose of this paper to investigate some of the properties of the generation of sound in this manner from a turbulent boundary layer. An integral theorem is derived which relates the motion of a fluid about a body of arbitrary shape to the stress distribution over the surface. This can be applied to obtain properties of the surface radiation field in given flows. When turbulent fluid moves across an infinite flat plate, and the motion is statistically homogeneous in planes parallel to the plate, the dipole sound radiated per unit area is shown to vanish. This is a consequence of the vanishing of the mean-square momentum per unit area of the shear layer, defined as the momentum of the fluid in a large area of the layer, squared, averaged and then divided by that large area. However, when the motion is not homogeneous in planes parallel to the plate, a non-zero acoustic radiation field may be set up. Therefore it is suggested that a semi-infinite flat plate placed in a uniform stream should produce a finite dipole radiation per unit area which becomes vanishingly small with increasing distance down the plate. A.

533.6.07

4249. A REMOTELY-CONTROLLED TRAVERSING YAWMETER FOR BOUNDARY-LAYER EXPLORATION.
D.W.Bryer.
J. sci. Instrum., Vol. 33, No. 5, 173-5 (May, 1956).

A high degree of accuracy, 0.001 in. in traverse and 0.05° in rotation, together with rapid operation and direct indication of position, is achieved by mounting the yawmeter on a micrometer mechanism which is controlled through felxible drives by reversible motors incorporating revolution counters. Details are given of the design, which includes safety devices and a system whereby the traverse is related to an accurate datum position. A.

MOLECULAR THEORY OF GASES 533.7

533.7

4250. ON THE SECOND VIRIAL COEFFICIENTS FOR ASSEMBLIES OF NONSPHERICAL MOLECULES. B.J.Castle, L.Jansen and J.M.Dawson.
J. chem. Phys., Vol. 24, No. 5, 1078-83 (May, 1956).

A method of calculating the second virial coefficients for nonspherical molecules is presented which differs from the usual procedure in the following ways: (a) The long-range directional forces between molecules are generally represented by a multiple expansion of the Coulomb interaction; this expansion is not valid for small intermolecular distances. However, these forces are usually extended into the region of small separations between molecular centres in the calculation of the second virial coefficients. The magnitude of the error introduced by this extension is investigated and found to be appreciable. The customary method is modified in such a way that the long-range orientational forces are cut off inside the molecular diameter r_0. (b) Effects resulting from anistropy in the London forces are taken into account. It is shown that this component of the directional field is usually predominant, even for molecules with large quadrupole moments. (c) Induction forces are considered, especially those resulting from permanent quadrupole moments. It is found that the effect of these forces is, in general, not negligible. The results are applied to an evaluation of the second virial coefficients for carbon dioxide, nitrous oxide, nitrogen, carbon monoxide, ethane, and ethylene. A comparison is made between the effects of the long-range directional forces on the physical properties of nitrogen, carbon monoxide, and carbon dioxide in the gaseous state and in the crystal. A.

533.7

4251. VIRIAL COEFFICIENTS AND MODELS OF MOLECULES IN GASES. B. T.Kihara.
Rev. mod. Phys., Vol. 27, No. 4 (I), 412-23 (Oct., 1955).

Extension of the treatment in a previous article (Abstr. 4261/1954) to the virial coefficients of helium, where quantum effects are important, and to the virial coefficients between unlike molecules. E.H.Sondheimer

533.75

4252. ISOTHERMS IN THE CRITICAL REGIONS OF CARBON DIOXIDE AND SULFUR HEXAFLUORIDE.
R.H.Wentorf, Jr.
J. chem. Phys., Vol. 24, No. 3, 607-15 (March, 1956).

The p-v isotherms were measured in the critical regions at 0.02°C temperature intervals while the gases were observed and photographed. It was found that the liquid-vapour boundary curve has a nearly flat top; this renders the classical van der Waals picture of the critical region inadequate. Some slight evidence was found for an anomalous critical region as predicted by Mayer, but this region could be only 0.04°C high for sulphur hexafluoride and less than 0.02°C high for carbon dioxide. It was found that constant pressure is rapidly achieved in the critical region, but that constancy of fluid structure requires five or more hours. The results of these experiments agree well with those of MacCormack and Schneider for sulphur hexafluoride and those of Michels for carbon dioxide. The influence of gravity upon critical phenomena was found to be large. A brief discussion of its effects and corrections to be made on account of it are given. A.

VIBRATIONS. ACOUSTICS 534

534.014.2

4253. EXPERIMENT IN FORCED OSCILLATIONS.
R.L.Henry.
Amer. J. Phys., Vol. 24, No. 4, 242-3 (April, 1956).

A device for a quantitative experiment in forced, damped oscillations is described. The oscillator is a torsion pendulum driven by a variable speed motor and damped magnetically. Provision is made for reading the amplitude of the resulting steady-state oscillations, as well as the phase difference between the angular displacement and the driving torque. These directly measured values can then be compared with values obtained from theoretical expressions. A.

534.11

4254. SOME INTERESTING CASES OF VIBRATING SYSTEMS. P.F.Bartunek.
Amer. J. Phys., Vol. 24, No. 5, 369-73 (May, 1956).

Three simple vibrating systems are described: The bifilar and trifilar pendula and the meter stick rocking on a cylindrical surface. All types afford challenging analytical problems. The bifilar pendulum with adjustable height of bob gives practice in scientific judgment, for of three possible modes of oscillation one is definitely best if one be interested in determination of g. The dumbbell model of bifilar pendulum, as well as the rocking stick, offer opportunities to study the effect of separately changing inertia and restoring factors. The trifilar pendulum offers an alternate to other common methods of measuring moments of inertia. A.

534.112

4255. INVESTIGATION OF THE RELATIONSHIP BETWEEN THE NUMBER OF MODES OF VIBRATION OF A LINEAR, ELASTIC BODY AND THE STRESS APPLIED TO THE INDIVIDUAL ELEMENTS OF MASS, PARTICULARLY AS APPLIED TO TRANSVERSE VIBRATIONS ON A WIRE. H.Fark.

Frequenz, Vol. 10, No. 3, 89-91 (March, 1956). In German.

The production of standing waves in wires vibrating in the transverse mode is described and details given of the production of the various harmonics. The Taylor formula is then used to calculate the order of the harmonic (k) in terms of the length of the wire (l), the mass per unit length (d), the frequency (n) and the stress (P) applied to the wire $k = 2\ln/g\,(d/P)^{1/2}$. The formula is then checked experimentally and obtained theoretically from the equations of vibration of a point on the wire. A.C.Whiffin

534.112 : 534.14

4256. RESPONSE OF STRINGS TO RANDOM NOISE FIELDS. R.H.Lyon.

J. Acoust. Soc. Amer., Vol. 28, No. 3, 391-8 (May, 1956).

A formulism for predicting the motion of continuous systems excited by random noise fields is applied to the special case of a one-dimensional string. Several examples are attacked: (1) Brownian motion of finite strings, (2) response to a spatially stepped-temporally delayed noise field, (3) response of finite ribbon to moving, random pressure fluctuations, (4) response of an infinite ribbon to moving, random pressure fluctuations. Cases (2) and (3) are investigated experimentally, the latter by using flowing turbulence. In case (2) appears the interesting phenomenon of the capability of the string "remembering" or "forgetting" a signal which it received in the past. The larger the damping of the string, the sooner it will forget a previous signal. In cases (3) and (4) a coincidence effect appears between the flow velocity of the forcing field and the velocity of waves on the ribbon. Here again, the phenomenon of forgetting appears and sharply determines the magnitude of any coincidence effect which may appear. A.

534.121.1

4257. THICKNESS-SHEAR AND FLEXURAL VIBRATIONS OF RECTANGULAR CRYSTAL PLATES. R.D.Mindlin and H.Deresiewicz.

J. appl. Phys., Vol. 26, No. 12, 1435-42 (Dec., 1955).

Equations governing thickness-shear and flexural vibrations of crystal plates are solved for the infinite plate, the simply-supported rectangular plate and the rectangular plate with one pair of parallel edges free and the other pair simply-supported. The equations permit three types of sinusoidal waves, with sinusoidal crests,in an infinite plate. Each of these undergoes a simple reflection upon normal incidence at a simply-supported straight edge, so that the frequency spectrum of a simply-supported rectangular plate has a relatively simple character. The results of a typical computation are given for the AT-cut of quartz. At a free edge each type of incident wave gives rise, in general, to all three types of reflected wave. Consequently, the frequency spectrum of a plate with a pair of parallel, free edges exhibits an intricate coupling of three infinite systems of modes. The development of the coupling is traced continuously by means of a solution involving elastically supported edges. A.

534.133

4258. RESONANCE AMPLIFICATION OF QUARTZ CRYSTALS. G.Bolz.

Z. angew. Phys., Vol. 7, No. 11, 514-16 (1955). In German.

A method is described for checking the validity of an approximate solution of the equations of a vibrating quartz crystal described in an earlier paper. (Z. angew. Phys., Vol. 2, 119, 1950). The method is based on the measurement of the resonance amplification observed at a given frequency for crystals of different thickness. The results show that the author's approximate solution gives correctly the static amplitude of a finite plate and also provides a better estimate of the amplitude at resonance than does the conventional solution for an infinite plate. H.J.H.Starks

534.141

4259. IMPROVED TYPE B FOG-HORN SYSTEM USING EXPONENTIAL AND CATENOIDAL HORNS. G.J.Thiessen.

J. Acoust. Soc. Amer., Vol. 28, No. 3, 356-62 (May, 1956).

The use of a high impedance acoustical load for the type B diaphone is capable of raising the efficiency of the fog-horn system to values of 10 to 16% for normal operating pressures. The high impedance is provided by a resonant exponential or catenoidal horn. To provide the high degree of frequency stability required by high Q resonant loads the mechanical impedance of the diaphone is reduced to permit it to lock in with the horn frequency. The reduction of the mechanical impedance is achieved by reducing the mass of the piston through the use of aluminium and reducing and stabilizing the frictional forces by using a central shaft for supporting the piston instead of allowing it to float in the liner. The resultin frequency stability is such that the efficiency under field conditions equals that obtained in the laboratory. An incidental benefit arises from the fact that the horns are smaller and made of aluminium reducing the weight by a factor of six. A.

534.21 : 539.37

4260. INTERFACIAL WAVES IN VISCOELASTIC MEDIA. C.-M.Tchen.

J. appl. Phys., Vol. 27, No. 5, 431-4 (May, 1956).

The stability of waves on the interface of two superposed semi-infinite layers of incompressible media is studied. The two uniform layers are of different densities and different viscoelastic properties. Gravity, Taylor acceleration, and surface tension are taken into consideration. The main problems considered are the dispersion, decay and growth of waves, and the formation of a hydrodynamical foundation for the cohesive action of elasticity. A

534.21

4261. PROPAGATION OF LONGITUDINAL WAVES AND SHEAR WAVES IN CYLINDRICAL RODS AT HIGH FREQUENCIES. H.J.McSkimin.

J. Acoust. Soc. Amer., Vol. 28, No. 3, 484-94 (May, 1956).

Exact steady-state solutions for both longitudinal waves and shear waves travelling in isotropic rods of circular cross section are analysed. Numerical examples are described for rods of large diameter to wavelength ratio. The effect of mode conversion on the propagation of short duration longitudinal wave trains is considered; and an approximate expression for the resulting loss is developed. Experimental results for 10-25 Mc/s longitudinal and shear waves in fused silica rods of 1.13 cm radius are described. A

534.22/.23 : 532.

4262. VELOCITY AND ABSORPTION OF ULTRASONIC WAVES IN SEVERAL NONASSOCIATED LIQUIDS UNDER HIGH PRESSURE. J.F.Mifsud and A.W.Nolle.

J. Acoust. Soc. Amer., Vol. 28, No. 3, 469-77 (May, 1956).

The ultrasonic-wave velocity and absorption for carbon tetrachloride, benzene, and carbon disulphide are measured by a pulse-reflection method, at several temperatures, in the pressure range of 1 to 1360 atmospheres. Generally similar pressure effects are found in the three liquids. The velocity increases with pressure to about 1.4 times the atmospheric-pressure value, while the relative absorption decreases to about 0.4. The structural relaxation theory, which is examined with reference to carbon tetrachloride, predicts approximately the pressure effect on the absorption at constant temperature, but gives erroneous predictions of the magnitude of the absorption, and of the effects of pressure on the absorption temperature coefficient and on the relaxation frequency. The

hermal relaxation theory is partially examined with reference o carbon disulphide, although more extensive data and further efinement of the theory are needed for a rigorous test. In erms of this theory, the absorption data are consistent with pproximate theoretical predictions of the effect of pressure pon the relaxation frequency and upon the relaxational portion f the specific heat. Over all, the study tends to confirm the hermal relaxation theory of the excess absorption in non-ssociated liquids. It is shown also that the Tonks equation of tate gives approximately correct values of the pressure co-fficient of sound velocity for carbon disulphide. A.

534.22 : 532.7

263. DETERMINATION OF ULTRASONIC VELOCITY IN OME COMPLEX CHLORIDES OF MERCURY. J.R.Saraf nd P.N.Sharma.
urr. Sci., Vol. 24, No. 10, 332-3 (Oct., 1955).

Additional evidence has been obtained favouring the existnce of the ion $HgCl_3^-$, the velocity — KCl concentration showng a discontinuity at $KCl.HgCl_2$. T.C.Toye

534.222.2

264. THE PROPAGATION AND STRUCTURE OF SHOCK VAVES OF VARYING STRENGTH IN A SELF-GRAVITATING AS SPHERE. M.H.Rogers.
roc. Roy. Soc. A, Vol. 235, 120-36 (April 10, 1956).

A general method is given for describing the motion of a pherically symmetric shock wave of varying strength in a gas here the density ahead of the shock front varies with distance rom the centre. The method applies only as long as the density oes not become zero ahead of the shock front at any instant. he motion is initiated by a central explosion which liberates a iven amount of kinetic energy. The density distribution ahead f the shock front is shown to have an important effect on the ariation in the shock strength, and a first approximation to the quation of motion of the shock front is deduced. A particular xample is worked out in detail, and it is shown that for certain ensity distributions the blast wave consists of a thin shell of as while the remainder of the original sphere is left intact. A.

534.23

265. ACOUSTIC RELAXATION BY RADIATION. .J.Lukasik.
. Acoust. Soc. Amer., Vol. 28, No. 3, 455-8 (May, 1956).

The effect on the vibrational and rotational relaxation me of de-excitation by photon emission in four gases possesing a permanent electric dipole moment is investigated. Such adiative energy losses are independent of pressure, and may e expected to control the relaxation process at low pressure hen collisions become relatively infrequent. Calculations are hown for N_2O, OCS and SO_2. Estimates of the efficiency of ollisions to deactivate a vibrational level in HCl, indicate that ie radiation effect on the vibrational relaxation time of this gas hould be the easiest to measure; at a pressure of 10^{-2}-10^{-3} tmos, de-excitation by radiation should be as important as ollisional de-excitation. Radiative de-excitation will become ncreasingly important at low temperatures because of the conequent increase of the collisional relaxation time. A.

534.23 : 532.73

266. ULTRASONIC RELAXATION IN AQUEOUS SOLUIONS OF N_2O_4. M.Krishnamurthi and M.Suryanarayana.
urr. Sci., Vol. 24, No. 11, 369-70 (Nov., 1955).

Measurements on solutions of N_2O_4 show further justificaon for attributing the relaxation phenomenon to the effect of e ultrasonics on the chemical equilibrium. This was preously found by one of the authors for solutions of SO_2 (Abstr. 34/1955). T.C.Toye

534.231 : 534.512.1

267. THE ARRANGEMENT OF PARTICLES AND SOLUIONS IN A STANDING ULTRASONIC FIELD. G.Keck.
custica, Vol. 5, No. 4, 243-4 (1955). In German.

A short discussion of the pressure distribution in a field of standing ultrasonic waves in liquids. T.C.Toye

534.232

4268. AIR-STIFFNESS CONTROLLED CONDENSER MICROPHONE. T.J.Schultz.
J. Acoust. Soc. Amer., Vol. 28, No. 3, 337-42 (May, 1956).

A very small condenser microphone has been developed which exploits materials and methods of construction only recently made available by the post-war developments in plastics. These techniques have made possible a microphone with extremely regular voltage amplitude and phase response as functions of frequency and with a reasonably high sensitivity. An analysis is given for the resonance frequencies of a circular membrane stretched over a closed cavity with its centre fixed over a small area. A.

534.232

4269. IRON-ALUMINUM ALLOYS FOP USE IN MAGNETOSTRICTIVE TRANSDUCERS. M.T.Pigott.
J. Acoust. Soc. Amer., Vol. 28, No. 3, 343-6 (May, 1956).

A systematic determination of the electromechanical coupling coefficient k has been made for Fe—Al alloys containing aluminium percentages between 12 and 14 by weight and annealed at temperatures between 600° C and 1100° C. For annealing temperatures in the neighbourhood of 1000° C, k^2 is about equal to 0.05 and is nearly independent of composition, a result in agreement with earlier measurements of Masumoto. For lower annealing temperarues, k^2 becomes sensitive to composition, the highest value measured being equal to 0.12 for an alloy containing 12.3% Al and annealed at 650° C. In all cases eddy current losses are lower for Fe—Al than for soft annealed "A" nickel. A.

534.232

4270. ULTRASONIC GENERATION WITH FERRITES. U.Enz.
Tech. Mitt. PTT, Vol. 33, No. 6, 209-12 (1955). In German.

Certain ferrites have magnetostrictive factors higher than Ni. Furthermore, their eddy-current losses are low and they are unaffected by acids and alkalis. They are, however, mechanically weak so that, although in theory they are capable of developing an output drive of 1 kW/in²., the maximum practical breaking load in water ranges from 10 to 120 W. Prestressing by means of steel clamps raises the breaking load. By making one end of the element cone-shaped, the mechanical movement is magnified and accelerations of 100 000 g can be achieved. Such magnetostrictive ferrite elements can be used for (a) measurement work such as the determination of elasticity, material testing, etc., and (b) processing such as emulsifying, degassing of liquids, cleansing and machining operations. A driving generator is briefly described. H.G.M.Spratt

534.24 : 535.39 : 538.566

4271. FOURIER TRANSFORM METHOD FOR THE TREATMENT OF THE PROBLEM OF THE REFLECTION OF RADIATION FROM IRREGULAR SURFACES. W.C.Meecham.
J. Acoust. Soc. Amer., Vol. 28, No. 3, 370-7 (May, 1956).

A method is presented which can be used for the calculation of the distribution of energy reflected from irregular surfaces. The formulation is useful for the first boundary value problem and can be used in either two- or three-dimensional problems with any given incident field. The solution is reduced to quadrature with negligible error when the average square of the slope of the reflecting surface is small and when the wavelength of the incident radiation is not small compared with the displacement of the surface from its average value. A numerical example is worked, the sinusoidal surface, and is compared with experiment and with a method due to Rayleigh. It is found that the Fourier transform method is preferable to previous methods, notably those which can be classified as physical optics (such as Rayleigh's), since the error in the transform method is of second order in the surface slope whereas

the error in previous methods is of first order in the same quantity. A.

534.26

4272. SCATTERING OF SOUND BY SOUND. U.Ingard and D.C.Pridmore-Brown.
J. Acoust. Soc. Amer., Vol. 28, No. 3, 367-9 (May, 1956).

Calculations and measurements are reported of the summation and difference frequency components which are scattered from the interaction region of two sound beams in air intersecting each other at right angles. A.

534.26

4273. DIFFRACTION OF A LONGITUDINAL PULSE FROM A WEDGE IN A SOLID. W.W.Grannemann.
J. Acoust. Soc. Amer., Vol. 28, No. 3, 494-7 (May, 1956).

The diffraction theory developed by Sommerfeld and extended by Pauli is used to approximate the relative amplitude of the diffracted pulses from a wedge in a solid. The geometric terms are neglected and the amplitude of the diffracted wave is obtained from the contour integral. Barium titanate transducers are used for sources and receivers on tar and concentrate models to check the predictions of the theory. Several relative amplitude v. distance curves are given for regions where the diffracted pulse is separated from other waves. The experimental and theoretical curves agree to $\pm$ 4 decibels in the regions tested. A.

534.26

4274. ON THE CAUSES AFFECTING THE PHASE GRATING PERMANENCE, AT THE STOPPING OF THE ULTRASOUNDS. F.Porreca.
Nuovo Cimento (Ser. 10), Vol. 3, No. 2, 371-6 (Feb., 1956).

Some experimental facts are related which allow an important role to be ascribed to electrostatic causes in the formation of the phase grating which builds up in suspensions traversed by ultrasound and persists when it is stopped. One may indeed observe that the effect manifests itself in suspensions of polar liquids and is absent in apolar ones. Moreover, in suspensions of mixtures of liquids, which singly produce the effect, it fails in the concentration range in which there are grounds to assume that the maximum number of molecular associations builds up. Finally the first results are given on the permanence time of the diffracted lines at the stopping of ultrasound, in suspensions of starch in electrolytic solutions, which shows a diminution of the effect with increasing concentration of the ions in suspension. On the basis of these experimental results it is affirmed that the permanence effect manifests itself when the suspended particles are surrounded by free dipoles of the liquid so as to present around them a zone whose active index is different from that normal to the liquid. In this way the particles which are ordered by the stationary ultrasonic waves in planes equidistant by 5/2 build up a phase grating of their own with the same periodicity. A.

534.321 : 612.85

THE OBSERVATION OF THE TARTINI PITCH. See Abstr. 4131

534.39

4275. DO SOUND WAVES POSSESS AN IMPULSE? W.Brenig.
Z. Phys., Vol. 143, No. 2, 168-72 (1955). In German.

The author shows on theoretical grounds that sound waves of energy E by their interaction with matter behave as if they possessed an impulse p = E/C (where C is the velocity of sound), thereby the stimulation of the sound waves by the simultaneous interaction will always produce a transport of matter with impulse p. A.B.Wood

534.614

4276. MEASUREMENT OF VELOCITY OF SOUND IN GASES. D.Bancroft.
Amer. J. Phys., Vol. 24, No. 5, 355-8 (May, 1956).

A method of determining the velocity of sound by observing the frequencies of radial oscillation of a gas confined in a spherical cavity is described. The accuracy appears to be comparable with that of the best methods available to date. A few preliminary results are quoted for argon, oxygen and CO_2. The possibility of utilizing the measurements for determination of the absolute temperature of the ice point is discussed. A

534.614

4277. A NEW METHOD OF MEASURING ULTRASONIC VELOCITY IN SOLIDS. S.Gopala Menon.
Curr. Sci., Vol. 25, No. 1, 9-10 (Jan., 1956).

A parallel beam of monochromatic light is passed through two parallel tanks containing liquid in which ultrasonic waves moving in a direction perpendicular to the light are produced by a quartz oscillator at one end, the one piece of quartz exciting waves in both tanks. Two wedges of the solid under test are placed in the liquid at one end of one of the tanks so that the thickness of the path which they insert in the beam of ultrasound can be adjusted by varying the height of one of the wedges. The diffraction pattern observed is at a minimum when there is a phase difference π between the two ultrasonic fields and the position of the wedge is adjusted to give successive dark positions. The velocity of ultrasound in the solid is computed from these positions, the angle of the wedge, the frequency and the velocity in the liquid. A.C.Whiffin

534.61

4278. NEW METHOD FOR MEASURING ULTRASONIC VELOCITY IN SOLIDS. S.Gopala Menon.
J. Acoust. Soc. Amer., Vol. 28, No. 2, 312-13 (March, 1956).

The method is based on Debye–Sears diffraction effects, when a plane wave front of light traverses in succession two ultrasonic fields of the same frequency. The method is applicable to homogeneous solids, transparent as well as opaque, only small specimens being required for the purpose. A

534.7

PHYSIOLOGICAL ACOUSTICS. HEARING. See also under "Medical science. Human physiology". Decimal classification 612.85.

534.78

4279. DELAYED FEEDBACK AS A MEANS OF SPEECH INVESTIGATION. W.Meyer-Eppler.
Elektron. Rdsch., Vol. 10, No. 4, 91-3 (April, 1956). In German.

If an individual speaks into a microphone, the output of which is fed back to both ears by means of close-fitting receivers, his speech deteriorates when a delay of ~ 0.1-02 sec. is introduced into the feedback chain. This is known as the Lee effect. This deterioration, which almost invariably occurs except in the case of the hard-of-hearing, appears to take the form of a combination of all the various types of stammering. In addition, the pitch of the voice and the speaking rate change. The cause is studied with relation to the mechanism of speech production. The technique has applications in detecting feigned deafness and in psychiatry. H.G.M.Sprat

534.791

4280. A RE-DETERMINATION OF THE EQUAL-LOUDNESS RELATIONS FOR PURE TONES. D.W.Robinson and R.S.Dadson.
Brit. J. appl. Phys., Vol. 7, No. 5, 166-81 (May, 1956).

Describes a new determination in free-field conditions which has been carried out at the National Physical Laboratory. The equal-loudness contours are of considerable importance, being fundamental to a proper understanding of aural judgment of the loudness of sounds of all kinds. They are also concerned in numerous practical applications in the study of noise. The

first set of contours for free-field conditions was given by Fletcher and Munson in 1933, and a second determination was carried out by Churcher and King in 1937, but these two investigations showed considerable discrepancies over parts of the auditory diagram. The present work has been carried out on a more extensive scale, using a large team of otologically normal persons, and new techniques have been introduced enabling reliable measurements to be made over a wider range of intensity than has hitherto been possible. The new results cover a range of frequency of from 25 to 15 000 c/s and of sound pressure level up to about 130 dB relative to 0.0002 dyn/cm^2. The data show a greater degree of regularity than the former results, and allow the equivalent loudness of a pure tone of any frequency to be expressed by formulae quadratic in the sound pressure level, the coefficients varying smoothly with frequency. The results include a new determination of the normal threshold of hearing in free field, which is highly consistent with the equal-loudness contours. At frequencies above 1000 c/s account needs to be taken of variations due to the age of the observers, which become of particular importance at the upper end of the frequency range. The new results have indicated the causes of some of the discordant features in the earlier determinations and it is hoped that the work will facilitate agreement on a standard set of equal-loudness contours. On account of its relevance to noise measurment, some extension to equal-loudness relations for bands of noise is being undertaken. A.

534.791

4281. IDENTIFICATION OF SOUND LEVEL AND "MATCHING FROM SAMPLE". I.Pollack.
J. Acoust. Soc. Amer., Vol. 28, No. 3, 412-15 (May, 1956).

The "identification" and "discrimination" of components of elementary auditory displays are here differentiated in terms of the relative contiguity between the unknown signal and the set of possible signals that may be chosen. Listeners attempted to match arbitrary designations to sound levels of a tone under three conditions of relative contiguity between the unknown sound level and the set of possible sound levels. Significant improvements in matching are associated with increasing contiguity, especially under finely subdivided conditions encompassing a wide range of sound levels. A.

534.862.4 : 534.76

4282. A COMPARISON BETWEEN REPRODUCED AND "LIVE" MUSIC. R.Vermeulen.
Philips tech. Rev., Vol. 17, No. 6, 171-7 (Dec., 1955).

To ascertain how far stereophonic reproduction can be distinguished from "live" music, comparative tests were carried out, in which the persons taking part in the tests (more than 300) were given no clue as to whether they were listening to "live" music (a small ensemble, concealed from view) or to a stereophonic reproduction thereof. Ten tests were made per session and, for each test, the participants had to give written answers to two questions. Question I concerned the ability to discriminate between the "live" music and the imitation, and question II the "naturalness" of the music. The answers were treated statistically. The general conclusion reached is that, of the average of 75 correct answers out of a 100, 50 are attributable to discernment of the difference and 25 to guessing. Relatively few people (16%) can identify the difference with certainty, however, and then only with difficulty. A postscript reports on similar experiments carried out in the Amsterdam Concertgebouw and in the "Akademisch Genootschap" building in Eindhoven. A.

OPTICS. RADIATION. SPECTRA 535

535.13

4283. ON COHERENCE PROPERTIES OF LIGHT WAVES. A.T.Forrester.
Amer. J. Phys., Vol. 24, No. 4, 192-6 (April, 1956).

The electric field of a luminous region is much more regular than is generally realized. Phases vary periodically and predictably, and the nature of the polarization remains approximately constant, for times of the order of the reciprocal of the line width in cycles per second. In a plane at right angles to the mean direction of propagation the light wave is coherent over an area approximately λ^2/Ω, where Ω is the solid angular spread in the light. These ideas, when applied to the problem of producing beats between light waves, lead to a signal amplitude which has been verified experimentally. A.

535.223

4284. ELECTRICAL MEASUREMENT OF THE SPEED OF LIGHT WITH A CLOCK AND MEASURING RODS. G.W.Clark.
Amer. J. Phys., Vol. 24, No. 4, 189-91 (April, 1956).

An experiment is described for the complete determination of the ratio of the absolute units of charge. The only calibrated measuring instruments used are a meter stick, a micrometer, and a clock. The accuracy of the measurement is approximately 5%. A.

535.231.2

4285. MONOCHROMATIC APPROXIMATION OF BLACK-BODY RADIATION. D.Shanks.
Amer. J. Phys., Vol. 24, No. 4, 244-6 (April, 1956).

An approximate theory of blackbody radiation is given which is not correct quantitatively and therefore cannot be taken too seriously. Nonetheless its extreme simplicity and moderate accuracy gives it a number of didactic and intuitional advantages. The Wien displacement and Stefan—Boltzmann radiation laws are deduced very simply. The exponent of T in the latter is seen to be the number of dimensions of space-time, that is, four. A simple formula for Avogadro's Number, N = PV/pv, is derived and discussed. A.

535.24 : 628.9

4286. RECOMMENDATIONS OF THE 13TH SESSION OF THE INTERNATIONAL COMMISSION ON ILLUMINATION. Y.Le Grand.
Rev. Opt., Vol. 34, No. 10, 525-8 (Oct., 1955). In French.

An account, with witty commentary, of the recommendations made in matters of nomenclature, daylight and lighting education. There is now no special name for the unit of luminance which is to be expressed in candelas per unit area. The word "radiance" is admitted as the English equivalent of "luminance énergétique" which remains the accepted term for the radiation analogue of luminance. The symbol is now M instead of H. The colorimetric observer data are being redetermined and this will involve a revision of the relative luminous efficiency function V_λ. Daylight factor is now broken down into three components each with an appropriate name and definition. J.W.T.Walsh

535.317

4287. ON THE VECTORIAL INTENSITY LAW IN GEOMETRICAL OPTICS. R.S.Ingarden and A.Krzywicki.
Acta phys. Polon., Vol. 14, No. 3, 255-6 (1955).

Friedlander has derived a vectorial intensity law, i.e. a law concerning the vectors E and H. The derivation is shown to contain a small but essential error. The correct form of the equation is obtained and is shown to be in accord with Poyntings law. R.W.Fish

535.317.4/.6

4288. CORRECTION OF THE ABERRATIONS INTRODUCED BY AN INCLINED PLATE IN CONVERGENT LIGHT. B.Cuny.
Rev. Opt., Vol. 34, No. 9, 460-4 (Sept., 1955). In French.

The astigmatism and coma introduced by an inclined plate can be removed by having the two surfaces inclined to each other by some small angle. It is shown that simultaneous correction of both aberrations cannot be achieved always, although the residuals are very small. R.W.Fish

535.321 : 535.325

4289. MEASUREMENT OF THE INDEX OF REFRACTION OF AIR AT 1.74 μ. F.Legay.
C.R. Acad. Sci. (Paris), Vol. 242, No. 8, 1008-10 (Feb. 20, 1956). In French.

A description is given of the determination of the refractive index of air which is dry and free of CO_2 at the wavelength 1.737 μ, using a Twyman interferometer. The interferometer was simultaneously illuminated with a mercury lamp and a Nernst filament. The circular fringes were projected on to the slit of a spectrograph. The value found for the refractive index is $(\mu - 1) \times 10^6 = 273.13$. S.Tolansky

535.33 : 539.152.2

4290. OPTICAL METHODS OF MAGNETIC RESONANCE. J.Brossel.
Cahiers de Phys., No. 65, 59-67 (Jan., 1956). In French.

A review of the work by Brossel, Kastler, etc. on the optical detection of radiofrequency resonance in atoms. D.H.Whiffen

535.33.07

4291. AUXILIARY RECORDING SYSTEM FOR THE PERKIN-ELMER MODEL 21 SPECTROPHOTOMETER. A.L.Olsen, D.J.Johnson and H. Pierson.
J. Opt. Soc. Amer., Vol. 46, No. 5, 354-8 (May, 1956).

An auxiliary recording system has been developed to provide simultaneous tracing by electronic means on 8½ x 11 in. paper. The entire mechanical range of the basic instrument is covered, providing a procedure readily adaptable to any prism and presenting absorption phenomena on any abscissa-ordinate scale. The dual trace is made without adversely affecting the performance of the basic instrument. Excellent resolution is achieved throughout the 2 to 15 micron range. In addition a secondary time-base drive system, operating integrally with the basic instrument, has been developed to provide an intermittent signal to the drum-axis of the auxiliary recorder. Thus, cyclic measurements of absorption phenomena are presented as a succession of progressively altered traces of absorption peaks. The reduced spectral traces provide condensed charts for cataloguing, facilitate reference and comparison studies, and are useful in the preparation of reports. A.

535.33.07

4292. A LARGE OPTICAL SLIT MECHANISM EMPLOYING SPRING MOVEMENTS. R.V.Jones.
J. sci. Instrum., Vol. 33, No. 5, 169-73 (May, 1956).

A spring layout is described for producing symmetrical movement in an optical slit 10 cm long, and capable of operating at any width between 5 and 1000 μ. Such factors as the parallelism and separation of the jaws are made independent of gravity by suitable arrangement of spring strength and disposition of centres of gravity of the moving members. The jaw edges are optically worked to confine width variations along the slit to about ± 0.15 μ r.m.s., and the jaws can be set parallel by eye and hand to within about 0.3 μ variation in the 10 cm length. A.

535.33.07

4293. THE CONSTRUCTION OF A COMBINATION GRATING SPECTROGRAPH OF HIGH DISPERSION. J.Weinard.
Z. angew. Phys., Vol. 7, No. 12, 584-8 (1955). In German.

Practical details are given of a spectrograph which is effectively a combination of a Paschen and a Wadsworth system. By the incorporation of three plane mirrors in the system, two of them rotatable, it is simple to change from one system to the other without moving the slit or grating. R.W.Fish

535.331

4294. VACUUM WAVELENGTH MEASUREMENTS IN THE ULTRA-VIOLET SPECTRUM OF IRON. J.Blackie and T.A.Littlefield.
Proc. Roy. Soc. A, Vol. 234, 398-404 (Feb. 21, 1956).

The vacuum wavelengths of twenty-seven lines in the spectrum of iron have been measured in the region 2456 to 2853 A using a reflecting echelon interferometer. Since the standard error is less than ±0.0001, and this is supported by an examination of inter-level differences, the wavelengths have been expressed to eight significant figures. A.

535.33

4295. THE SPECTRUM OF XENON BETWEEN 21 000 AND 27 000 A. G.Hepner.
C.R. Acad. Sci. (Paris), Vol. 242, No. 11, 1430-1 (March 12 1956). In French.

A brief note listing emission lines in the infrared using a Geissler discharge, echelette grating and PbS cell. J.D.Craggs

535.333

4296. EMISSION SPECTRA OF NITROGEN IN THE VACUUM ULTRAVIOLET. P.G.Wilkinson and N.B.Houk.
J. chem. Phys., Vol. 24, No. 3, 528-34 (March, 1956).

The emission spectra of nitrogen have been photographed in the vacuum ultraviolet under high resolution. Selected bands of the $b' {}^1\Sigma_u^+ - X^1\Sigma_g^+$ and the $a^1\Pi_g - X^1\Sigma_g^+$ systems have been analysed and new rotational and vibrational constants obtained. The observed Λ-type doubling of the $a^1\Pi_g$ state was used to determine that the F_c' doublet component lies above the F_d' component. Rotational perturbations were found in the v = 0 level of the $a^1\Pi_g$ state, and in the v = 0 and 1 levels of the $b' {}^1\Sigma_u^+$ state. Vibrational perturbations were found in the v = 4, 5 and 6 levels of the $b' {}^1\Sigma_u^+$ state and a new predissociation at v = 4, J = 9 was observed. The new predissociation limit lies at 13.233 eV and is equally compatible with either the 9.756 eV or the 7.373 eV ground-state dissociation energy. A.

535.333

4297. EMISSION SPECTRA IN THE ULTRAVIOLET OF CARBON TETRACHLORIDE AND DICHLORODIFLUOROMETHANE. T.El Khalafawi and A.Johannin-Gilles.
C.R. Acad. Sci. (Paris), Vol. 242, No. 13, 1716-18 (March 26, 1956). In French.

The spectrum of CCl_4 is very similar to that of chlorine, though the bands measured differ from those of previous authors. Maxima are given as 2340, 2200 and 1990 A. States are assigned to the transitions. For CF_2Cl_2 five bands between 2381 and 2328 A are listed, while both compounds give carbon lines between 1931 and 1560 A, and chlorine lines between 1396 and 1347 A. S.T.Henderson

535.33

4298. NEW VIBRATIONAL ANALYSIS OF THE VISIBLE EMISSION BANDS OF Cl_2^+. P.Tiruvenganna Rao and P.B.V.Haranath.
Curr. Sci., Vol. 25, No. 2, 47-8 (Feb., 1956).

535.338.332 : 539.153

NEW POINTS OF VIEW CONCERNING THE HYDROGEN ATOM AND THE HYDROGEN SPECTRUM. See Abstr. 3924

535.338.334

4299. THE CONTOUR OF SODIUM ARC LINES BROADENED BY INTERMOLECULAR STARK EFFECT. S.Weniger and R.Herman.
J. Phys. Radium, Vol. 17, No. 1, 37-41 (Jan., 1956). In French.

Briefly discusses inhomogeneous-field first-order Stark effect and the second-order effect due to electron impact. Then, after a description of methods available for estimating electron concentrations in high-density plasmas, experimental results obtained with a condensed spark discharge through hydrogen–sodium vapour are described. Line profiles are shown, and "normal field strengths" obtained from the Balmer line H_β and certain sodium lines are compared and discussed. J.D.Craggs

535.338.4

4300. THE IDENTIFICATION OF A BAND SYSTEM $B(^2\Sigma^+)-A^2\Sigma^+$, IN OH AND OD. R.F.Barrow and A.R.Downie.
Proc. Phys. Soc. A, Vol. 69, Pt 2, 178-80 (Feb., 1956).

New analyses of previously published measurements show that the bands discovered by Schüler and Woeldike (Physikalische Zeitschrift, Vol. 44, 435, 1943) arise from a transition in the neutral OH molecule. The dissociation energy, D_0'', of OH is found to be 101.5 kcal. R.F.Barrow

535.338.4

4301. THE RADIATION OF CO_2 IN THE REGION OF 15 μ IN AN ELECTRIC DISCHARGE. N.Ya.Dodonova and V.V.Sobolev.
Zh. éksper. teor. Fiz., Vol. 28, No. 6, 764-6 (1955). In Russian. English translation in Soviet Physics JETP (New York), Vol. 1, No. 3, 611-13 (Nov., 1955).

Measurements were made in the pressure range 10-200 mm Hg with a 280 mA discharge. The emission band at about 13.7 μ wavelength was studied; data on pressure variations of intensity with CO_2 only, and with admixture of N_2 and H_2 are given. The results are discussed briefly and compared with those of other authors. J.D.Craggs

535.343

4302. SPECTROSCOPIC PROPERTIES OF ORGANIC PHOTOCONDUCTORS. II. SPECULAR REFLECTION SPECTRA OF CATIONIC DYE FILMS. J.W.Weigl.
J. chem. Phys., Vol. 24, No. 3, 577-80 (March, 1956).

For Pt I, see Abstr. 1972 (1956). The specular reflectivity of solid dye films has been measured at 12° incidence, by means of a new device attached to the Beckman Quartz Spectrophotometer. The observed spectra are in general agreement with the results of dispersion theory. A.

535.343

4303. SPECTROSCOPIC PROPERTIES OF ORGANIC PHOTOCONDUCTORS. III. ACTION SPECTRA FOR THE PHOTOCONDUCTION OF CATIONIC DYE FILMS. J.W.Weigl.
J. chem. Phys., Vol. 24, No. 4, 883-7 (April, 1956).

For Pt II, see preceding abstract. The action spectra for photoconduction in solid films of four cationic dyes have been measured. Both the response and the quantum yield curves have maxima at the main absorption peaks, which correspond to the singlet-singlet transitions of the dye cations. The maximum efficiency of carrier production in rhodamine B is of the order of 0.1 electron excited per quantum absorbed. A.

535.343

4304. THE ABSORPTION SPECTRUM OF EXCITED CRYSTALS OF CADMIUM SULPHIDE. A.Halperin and G.F.J.Garlick.
Proc. Phys. Soc. B, Vol. 68, Pt 10, 758-65 (Oct., 1955).

Crystals of cadmium sulphide show new absorption bands when excited by visible light (0.546 μ). The bands extend from the excitation region out to 1.4 μ with a maximum intensity at 0.78 μ. The bands are stable in the dark at low temperatures but are thermally bleached on warming. They are also bleached by radiation of their own wavelength. Correlation is found between thermal bleaching characteristics and electrical conductivity characteristics. A model is proposed in which thermal bleaching and electrical conduction on warming result from the escape of trapped electrons, while optical bleaching frees positive holes which migrate to traps and recombine with trapped electrons. A.

535.343 : 548.7

4305. THE ABSORPTION SPECTRA OF NATURAL AND IRRADIATED DIAMONDS. C.D.Clark, R.W.Ditchburn and H.B.Dyer.
Proc. Roy. Soc. A, Vol. 234, 363-81 (Feb. 21, 1956).

The absorption spectra of fifty-two natural diamonds have been measured at 80 and 290°K. Type I diamonds are shown to have two kinds of absorption centres which are not detected in type II diamonds. Differences in the infrared absorption spectra between type IIa and type IIb diamonds are reported. The classification of diamonds is discussed. The absorption produced by irradiating diamonds with electrons, neutrons and γ-rays is described. The general nature of the changes produced by the different forms of radiation is the same, but significant differences in the breadths and wavelengths of the induced absorption lines have been observed. Electron-irradiated type IIa diamonds show absorption lines not observed in irradiated type I diamonds. There is a similarity between the sets of natural absorption lines in type I diamonds and those produced by irradiation. A model relating the induced absorption to interstitial carbon atoms, vacant atomic sites and regions of amorphous or graphitic carbon is proposed. A.

535.343

4306. ON THE ABSORPTION SPECTRUM OF NITRIC OXIDE IN THE FAR ULTRAVIOLET. J.Granier and N.Astoin.
C.R. Acad. Sci. (Paris), Vol. 242, No. 11, 1431-3 (March 12, 1956). In French.

Extinction coefficients have been measured in the range 150 to 1100 A. R.F.Barrow

535.343

4307. ANALYSIS OF THE NEAR ULTRAVIOLET ABSORPTION SPECTRUM OF PYRIDINE N-OXIDE VAPOR. M.Ito and W.Mizushima.
J. chem. Phys., Vol. 24, No. 3, 495-500 (March, 1956).

The near ultraviolet absorption spectrum of pyridine N-oxide vapour was studied under a medium dispersion, and the vibrational analysis was made for the discrete band system near 3300 A. The electronic transition of this system is interpreted as an allowed A_1-B_2 transition arising from the excitation of a 2p nonbonding electron of the oxygen atom into the unoccupied π orbital. A.

535.343

4308. MISASSIGNMENT OF THE MULTIPLICITY FORBIDDEN TRANSITIONS IN PYRIDINE. G.J.Brealey.
J. chem. Phys., Vol. 24, No. 3, 571-3 (March, 1956).

Experimental work is described which indicates that the two previously assigned singlet-triplet transitions for pyridine, in the regions 29 000-33 000 cm^{-1} and 25 000-28 500 cm^{-1} are due to impurities. The higher energy absorption is shown to be due to an impurity of pyrazine in pyridine to the extent of 1 part in 150 000. This pyrazine impurity is shown to be responsible also for causing the apparent phosphorescence emission of pyridine in the region 26 600 to 20 000 cm^{-1}. A.

535.343

4309. ANALYSIS OF THE NEAR ULTRAVIOLET ABSORPTION SPECTRUM OF 1,2,4,5-TETRACHLOROBENZENE VAPOR. I.Matubara and T.Anno.
J. chem. Phys., Vol. 24, No. 3, 595-601 (March, 1956).

The absorption spectrum of the 1,2,4,5-tetrachlorobenzene vapour lying in the wavelength region between 3040 and 2650 A was photographed and measured. The band at 34 149 cm^{-1} is assigned as the 0,0 band. The progression with frequency intervals of 1134 cm^{-1} starts from the stronger bands. Most of the prominent bands are assigned to progressions or combinations of the possible fundamental frequencies. The fundamental frequencies are compared with the Raman values. A tentative assignment of the fundamental frequencies is discussed. The change of the molecular structure in the course of the electronic transition is also discussed. A.

535.343

4310. DETECTION OF FREE RADICAL ABSORPTION SPECTRA BY CHEMICAL MODULATION. E.J.Bair, J.T.Lund and P.C.Cross.
J. chem. Phys., Vol. 24, No. 5, 961-5 (May, 1956).

A method is described for studying free radicals by ab-

sorption spectroscopy. The principal feature is the maintenance of an oscillating free radical concentration, which takes advantage of the high momentary concentrations that follow pulses of energy, and yet may be integrated to provide a continuous free radical absorption signal. The problems of detecting absorption in these transient systems are discussed using NH_2 generated by an electrical discharge through ammonia as an example. A.

535.343

4311. CONTRIBUTION TO THE STUDY OF THE ABSORPTION AND REFLECTION SPECTRA OF CuI AND CuBr AT LOW TEMPERATURES. S.Nikitine, R.Reiss and G.Perny.
C.R. Acad. Sci. (Paris), Vol. 242, No. 12, 1588-90 (March 19, 1956). In French.

Observations on the exciton spectra at liquid hydrogen temperatures are reported. R.F.Barrow

535.343

4312. INFRARED SPECTRUM OF GASEOUS ALUMINUM CHLORIDE. W.Klemperer.
J. chem. Phys., Vol. 24, No. 2, 353-5 (Feb., 1956).

The infrared spectra of gaseous Al_2Cl_7 and $AlCl_3$ have been studied from 1200 to 325 cm^{-1}. Bands of Al_2Cl_6 have been observed at 625, 484, 420 cm^{-1}. One band of $AlCl_3$ at 610 cm^{-1} has been observed. A calculation of the force constants of these molecules is made. The methods used to obtain the spectra appear suitable for the study of substances which are volatile at high temperatures. A.

535.343

4313. GRATING MEASUREMENTS ON $\tilde{\nu}_2$ OF NO_2 AT 200°C. F.L.Keller and A.H.Nielsen.
J. chem. Phys., Vol. 24, No. 3, 636-7 (March, 1956).

Results of these more accurate measurements on this vibration-rotation band in the region 650-900 cm^{-1} agree well with the prism measurements of Abstr. 7617/1954. J.Hawgood

535.343

4314. INFRARED SPECTRA OF GASEOUS AND SOLID DIGERMANE. D.A.Dows and R.M.Hexter.
J. chem. Phys., Vol. 24, No. 5, 1029-33 (May, 1956).

The spectra were studied in the region 400-4000 cm^{-1}. The infrared-active fundamental frequencies are as follows: A_{2u}: 2078, 755; E_u: 2114, 898 and 407 cm^{-1}. Assignment of combination bands gives the remaining fundamentals: A_{1g}: 2070, 765, 229; A_{1u}: 144; E_g: 2150, 875 and 417 cm^{-1}. From the torsional frequency, a cosine barrier to internal rotation is 1200 cal. The structure of the perpendicular band at 898 cm^{-1} has been resolved, giving information connecting the Coriolis constant for this vibration with the molecular structure parameters. The spectrum of the solid, obtained at 90°K, shows only those fundamentals active in the gas phase. Small splittings or satellites are observed, and possible crystal symmetries are suggested. A.

535.343 : 539.132

4315. VIBRATION SPECTRA OF SOME MIXED HALIDES OF BORON. L.P.Lindeman and M.K.Wilson.
J. chem. Phys., Vol. 24, No. 2, 242-9 (Feb., 1956).

Mixed halides of boron have been shown to exist in binary mixtures of the trihalides. Most of the fundamental frequencies of BF_2Cl, $BFCl_2$, BF_2Br, $BFBr_2$, BCl_2Br and $BClBr_2$ for molecules containing boron-10 and boron-11 have been observed and assigned to the proper modes of vibration. With the aid of the trihalide frequencies a normal coordinate treatment has been made for the mixed halides. Some discussion of the validity of transferring force constants in this system is given. A.

535.343 : 539.133

4316. INFRARED ABSORPTION INTENSITIES AND BOND MOMENTS IN BF_3 AND RELATED MOLECULES. D.C.McKean.
J. chem. Phys., Vol. 24, No. 5, 1002-6 (May, 1956).

The infrared absorption intensities of the fundamental vibration bands of BF_3 have been measured and vibrational bond moments μ and their derivatives $\partial\mu/\partial r$ determined. In the A_2'' class, μ_{BF} = 1.7 D; in the E' class μ_{BF} = 0.9 or 2.6 D, $\partial\mu/\partial r$ = −6.1 or +4.0 D/A. Inspection of the form of the bending modes suggests that deviations from the bond moment approximation occur such that $\mu(A_2'') < \mu(\text{static}) < \mu(E')$. The solution $\mu(E')$ = 2.6 D is therefore preferred. Re-examination of the data of Schatz and Hornig on CF_4, SiF_4 and SF_6 in the light of the present results shows that the vibrational bond moments in these molecules are: $\mu_{CF} \sim 2.4$, $\mu_{SiF} \sim 3.3$, $\mu_{SF} \sim 2.7$ D. These moments are roughly equal to Δr_0, where r_0 is the bond length and Δ the electronegativity difference between the atoms in the bond. The available data on μ and $\partial\mu/\partial r$ for the C—F bond in various molecules are compared and briefly discussed. A.

535.343

4317. INFRARED ABSORPTION STUDIES OF AQUEOUS COMPLEX IONS. II. CYANIDE COMPLEXES OF Cu(I) IN AQUEOUS SOLUTION. R.A.Penneman and L.H.Jones.
J. chem. Phys., Vol. 24, No. 2, 293-6 (Feb., 1956).

For Pt I, see Abstr. 8164 (1954). In the system CuCN—KCN—H_2O, infrared absorption spectra of three distinct complex ions have been observed:

$Cu(CN)_2^-$, $\epsilon = 165 \pm 25$ mole^{-1} litre cm^{-1} at 2125 cm^{-1};
$Cu(CN)_3^=$, $\epsilon = 1090 \pm 10$ mole^{-1} litre cm^{-1} at 2094 cm^{-1}; and
$Cu(CN)_4^{\equiv}$, $\epsilon = 1657 \pm 15$ mole^{-1} litre cm^{-1} at 2076 cm^{-1}.

At 29°C, the constants for the dissociation of $Cu(CN)_4^{\equiv}$ into $Cu(CN)_3^=$ + CN^- are: $K_{4,3}^C = 0.0076 \pm 0.0005$ mole litre^{-1} [in terms of concentrations at 0.1 − 0.2f Cu(I)] and $K_{4,3}^a = 0.026$ mole litre^{-1} (in terms of activities). Analogous values for the dissociation of $Cu(CN)_3^=$ into $Cu(CN)_2^-$ + CN^- are $K_{3,2}^C = (2.44 \pm 0.36) \times 10^{-6}$ mole litre^{-1}, and $K_{3,2}^a = 4.2 \times 10^{-6}$. The above values are calculated from approximately 100 determinations. At 25°C, the corresponding values of these constants are approximately $K_{4,3}^C = 0.005_7$ and $K_{3,2}^C = 1._6 \times 10^{-6}$. Using the activity constants thus determined and a value of 1×10^{-24} for the constant: $[Cu^+][CN^-]^2\,[Cu(CN)_2^-]$ the following values are derived: $[Cu^+][CN^-]^3/[Cu(CN)_3^=] = 2.6 \times 10^{-29}$ and $[Cu^+][CN^-]^4/[Cu(CN)_4^{\equiv}] = 5 \times 10^{-31}$. The free energies of formation of the complex ions are thus: $Cu(CN)_2^-$, ΔF_f^0 = 58.5 kcal/mole; $Cu(CN)_3^{\equiv}$, ΔF_f^0 = 91.8 kcal/mole; and $Cu(CN)_4^{\equiv}$, $\Delta F_f^0 \equiv 129$ kcal/mole. A.

535.343

4318. INFRARED ABSORPTION SPECTRUM AT LOW TEMPERATURE OF CRYSTALLIZED ROCHELLE SALT (4400-7100 cm^{-1}). M.P.Bernard.
C.R. Acad. Sci. (Paris), Vol. 242, No. 8, 1012-13 (Feb. 20, 1956). In French.

Shows a curve of molecular extinction coefficients against wavelength, for radiations polarized with the electric vector parallel to each of the 3 crystal directions. Absorption maxima are tabulated and assignments suggested. G.F.Lothian

535.343

4319. INFRARED SPECTRUM OF BENZENE-d_6. F.A.Miller.
J. chem. Phys., Vol. 24, No. 5, 998-1001 (May, 1956).

Improved infrared data have been obtained for benzene-d_6 from 300-3700 cm^{-1} for both vapour and liquid phases. The frequencies can be interpreted very completely and satisfactorily. Good evidence was found for assigning ν_{14} and ν_{15} to 1287 and 838 cm^{-1} in benzene-d_6. This provides valuable confirmation for Mair and Hornig's choice of 1310 and 1152 in benzene itself. All the fundamental frequencies for both benzene and benzene-d_6 now seem to be well established, aside from small uncertainties in a few cases where the values have been inferred from combination tones or from the product rule. The

infrared spectrum of benzene vapour for the range 300-700 cm^{-1} is also given. A.

535.343

4320. VIBRATIONAL SPECTRUM OF TETRABROMOETHYLENE. D.E.Mann, J.H.Meal and E.K.Plyler.
J. chem. Phys., Vol. 24, No. 5, 1018-22 (May, 1956).

The infrared spectrum of C_2Br_4 in various solvents and as a liquid has been observed and measured in the range 3-100 μ The new data, in conjunction with earlier results and force constant calculations, have enabled for the first time an essentially complete and satisfactory vibrational assignment. The fundamentals, in units of cm^{-1}, are 1535, 265, 144 in a_{1g}; 880, 208 in b_{1g}; 766, 119 in b_{2u}; 635, 188 in b_{3u}; 66 in a_{1u}; 245 in b_{1u}; and 464 in b_{2g}. The present results for C_2Br_4 have required that two changes be made in the earlier assignment for C_2Cl_4. The angular modes of the chloro compound in b_{1u} and b_{3u} are now found to be at 288 and 310 cm^{-1}, respectively. The assignments for C_2F_4, C_2Cl_4, and C_2Br_4 are then complete and concordant. A.

535.343 : 535.337

4321. EFFECT OF PRESSURE ON THE FREQUENCY OF THE O—H BAND IN BUTANOL SOLUTIONS. E.Fishman and H.G.Drickamer.
J. chem. Phys., Vol. 24, No. 3, 548-53 (March, 1956).

The infrared spectra of dilute solutions of normal butanol have been observed in the 3-micron region at pressures from 10 to 12 000 atm. The sharp "monomeric" O—H band shifts toward lower frequencies as the pressure increases. If $\Delta\nu$ is defined as the shift in frequency from its value at one atm and 25° C in each solvent, $\Delta\nu$ at the maximum pressure varies from 11 cm^{-1} in 2, 3 dimethyl butane to 41 cm^{-1} in n-propyl iodide. The frequency shift is found to be a linear function of the square of the density and the polarizability of solvent bonds, though this latter relationship is not quantitative. The shifts are plausibly explained as due to van der Waals' forces between the O—H bond and the solvent. The pressure causes a large increase in the polymerization of the alcohol, from which the change of volume on polymerization is estimated to be −4.64 cm^3/mole in the 1 to 5820 atm range, and −2.47 cm^3/mole in the 5820 to 11 330 atm range. A.

535.343 : 535.347

4322. INFRA-RED SPECTRUM AND DICHROISM OF CRYSTALLINE ACETANILIDE. N.B.Abbott and A.Elliott.
Proc. Roy. Soc. A, Vol. 234, 247-68 (Feb. 7, 1956).

Spectra of acetanilide have been observed with the electric vector in turn along each of the three crystal axes over a wide frequency range for $CH_3CONHC_6H_5$, for $CH_3CONDC_6H_5$ and for a material which approximated to $CD_3CONHC_6H_5$. In addition, some observations have been made on crystals in which a very small proportion of the NH groups were replaced by ND. It has been found that the transition moment of the 1666 cm^{-1} (carbonyl) band is accurately in the plane of the amide group and makes an angle between 20 and 24° to the C=O bond, being inclined towards the direction of the CN bond. Transition moment directions for a number of other bands have been determined, though in some cases ambiguity arises because of the crystal symmetry. The effects of deuteration both of NH and of CH_3 groups are complicated and indicate that many bands arise from modes which are not localized in small groups within the molecule. Few of the bands disappear on melting, and it does not appear that the complications, except perhaps in the NH stretching modes, arise mainly from lattice effects. A.

535.343 : 539.132

4323. VIBRATIONAL SPECTRA OF FLUORINATED AROMATICS. X. P-FLUORCHLORO-, P-FLUOROBROMO-, AND P-FLUOROIODOBENZENE. N.A.Narasimham, M.Z.El-Sabban and J.R.Nielsen.
J. chem. Phys., Vol. 24, No. 2, 420-32 (Feb., 1956).

For Pt IX see Abstr. 2292 (1954). The infrared absorption spectra of liquid p-fluorochloro-, p-fluorobromo-, and p-fluoroiodobenzene, and the stronger bands of the first two compounds in the gaseous state, have been obtained in the region 2—38μ with NaCl and CsBr prisms. The Raman spectra of the compounds in the liquid state have been photographed with a 3-prism glass spectrograph of linear dispersion 15 A/mm at 4358 A, and depolarization ratios have been measured for the stronger Raman bands of p-fluorochloro- and p-fluorbromobenzene. Complete assignments of the fundamental vibrational frequencies have been made, and the spectra are interpreted in detail. A.

535.343 : 539.132

4324. VIBRATIONAL SPECTRA OF FLUORINATED AROMATICS. XI. O-FLUOROCHLOROBENZENE. N.A.Narasimham and J.R.Nielsen.
J. chem. Phys., Vol. 24, No. 2, 433-8 (Feb., 1956).

The infrared absorption spectra of gaseous and liquid o-fluorochlorobenzene have been obtained in the region 2—38μ with NaCl and CsBr prisms. The Raman spectrum of the liquid has been phorographed with a 3-prism glass spectrograph of linear dispersion 15 A/mm at 4358 A. A complete assignment of the fundamental vibrational frequencies is given, and the spectra are interpreted in detail. A.

535.343 : 541.57

4325. NATURE OF THE HYDROGEN BOND. III. THE MEASUREMENT OF THE INFRARED ABSORPTION INTENSITIES OF FREE AND HYDROGEN-BONDED OH BANDS. THEORY OF THE INCREASE OF THE INTENSITY DUE TO THE HYDROGEN BOND. H.Tsubomura.
J. chem. Phys., Vol. 24, No. 5, 927-31 (May, 1956).

For Pt II see Abstr. 1079 (1956). The integrated intensities of the infrared OH bands of various compounds have been measured for the free and the hydrogen-bonded states. It is found that the integrated intensity of either the free or the hydrogen-bonded OH band increases as the frequency decreases. It is concluded that the main factor increasing the integrated intensity of the intermolecularly hydrogen-bonded OH bands is the charge transfer through the hydrogen bond. The sign of the change of the dipole moment of the free phenol with the OH distance is discussed. An explanation is given for the weakness of the OH bands of the chelate compounds. A.

535.343

4326. SPECTRAL INVESTIGATIONS IN THE REGION NEAR 1 mm WAVELENGTH. IV. VACUUM SPECTROMETER. H_2S AND NH_3 ROTATION SPECTRA. L.Genzel.
Z. Phys., Vol. 144, No. 4, 311-22 (1956). In German.

For Pt III, see Abstr. 1951 (1956). The spectrometer described previously (Abstr. 2561/1955) has been evacuated to remove H_2O absorption and the Hg arc shown to give a continuous spectrum. The H_2S and NH_3 rotation spectra are investigated from 80 to 1000 μ and shown to agree with the known rotation and inversion constants. D.H.Whiffen

535.345 : 535.231.4

4327. ABSORPTION AND EMISSION OF LIGHT BY A GREY SUBSTANCE. B.I.Stepanov.
Zh. éksper. teor. Fiz., Vol. 28, No. 5, 559-66 (1955). In Russian. English translation in Soviet Physics JETP (New York), Vol. 1, No. 3, 446-51 (Nov., 1955).

A substance is defined as grey if its "absorption capacity" (ratio of energy absorbed to radiation density) is the same for all frequencies, and if its emissivity is proportional to that of a black body. The thermodynamical properties of such a substance are discussed. It is claimed that the results obtained are relevant to absorption and emission of light by complex molecules. L.Pincherle

535.371

4328. CONFIRMATION OF THE ANOMALOUS FLUORESCENCE OF AZULENE. G.Viswanath and M.Kasha.

J. chem. Phys., Vol. 24, No. 3, 574-7 (March, 1956).

The light emission properties of the azulene molecule and several alkyl-substituted azulenes have been studied. In confirmation of results of Beer and Longuet-Higgins, it is found that anomalous ($S'' \rightarrow S$) fluorescence occurs in azulene, with with $\bar{\nu}_{max}$ at 26 802 cm^{-1} (rigid glass solution in EPA at 77° K). Red-shifts for this fluorescence are found in several alkyl-substituted azulenes, in qualitative agreement with substitution theory. The absence of normal ($S' \rightarrow S$) fluorescence and the absence of any phosphorescence ($T \rightarrow S$) emission to 11 000 A, the apparatus limit, are also confirmed. The emission observations are discussed, and alternative interpretations are given. A.

535.371

4329. QUANTUM EFFICIENCY MEASUREMENTS ON SEVERAL PHOSPHORS UNDER EXCITATION IN THE EXTREME ULTRAVIOLET. D.H.Thurnau.
J. Opt. Soc. Amer., Vol. 46, No. 5, 346-9 (May, 1956).

The response of several inorganic phosphors to radiation in the wavelength range of 275 A to 1715 A has been explored. The chief apparatus employed was a grazing incidence vacuum grating monochromator, using both a hydrogen arc source and an air spark source. Sodium salicylate, whose quantum efficiency is reportedly almost independent of wavelength, was used as a reference phosphor; therefore, excitation spectra are given in terms of quantum efficiency relative to sodium salicylate. Excitation spectra for $CaMg(SiO_3)_2$: Ti, $CaSiO_3$: Mn : Pb and $3Ca_3(PO_4)_2 \cdot Ca(F, Cl)_2$: Mn : Sb are limited to a range from 1026 A to 1640 A, and all show a simple decline with decreasing wavelength. $CaWO_4$: Pb and Mg_2WO_5 : [W] show a minimum in quantum efficiency at about 1000 A; whereas $Zn_3(PO_4)_2$: Mn has a minimum at about 700 A. All of the latter three phosphors exhibit marked increases in quantum efficiency with decreasing wavelength in the extreme ultraviolet. A.

535.371

4330. NEW LIQUID SCINTILLATION PHOSPHORS. J.R.Arnold.
Science, Vol. 122, 1139-40 (Dec. 9, 1955).

7-diethylamino-4-methyl coumarin and 2 (p-dimethylaminophenyl) benzthiazole used as "whiteners" for detergents function as scintillators when in solution in toluene. No scintillations were observed in water solutions. G.F.J.Garlick

535.371 : 539.11

FLUORESCENCE TRANSFER IN SOLID SOLUTIONS OF AROMATIC HYDROCARBONS. See Abstr. 3874

535.375.5

4331. ARRANGEMENTS FOR THE PHOTOELECTRIC RECORDING OF RAMAN SPECTRA. J.Brandmüller and H.Moser.
Z. angew. Phys., Vol. 8, No. 2, 95-104 (1956). In German.

The first part of review of current practice (60 refs.). On light sources, low- and high-pressure mercury types, in particular the spiral Pyrex "Toronto" burner, are discussed, and compared for line and background intensities in the 4358 A triplet. A doubled output is obtained at this wavelength by the use of d.c. instead of a.c. operation. A circuit with two magnetic voltage stabilizers is described for external control of the mercury arc, while in the Toronto burner an internal stabilization is seen in certain ranges of temperature and loading. The optical conditions to obtain maximum irradiation of the sample are discussed; also, at greater length, various arrangements to provide maximum illumination of the spectrograph slit with or without auxiliary lenses, mirrors and prisms. A brief section on spectrographs has a table of figures of merit based on instrument dimensions and transmissions. S.T.Henderson

535.375.5

4332. THE PHOTOELECTRIC RECORDING OF RAMAN SPECTRA. II. J.Brandmüller and H.Moser.
Z. angew. Phys., Vol. 8, No. 3, 142-51 (1956). In German.

The concluding part of a review (see preceding abstract), with 21 refs. Secondary electron multipliers are described with details of construction, spectral sensitivity and electrical characteristics of commercial types, mainly with SbCs photocathodes. The necessity of providing stable operating potentials, the use of cooling to reduce dark current, and the importance of signal-to-noise ratio and of linearity of output, are next discussed, together with d.c. and a.c. amplifiers and recorders. The resolution obtainable is shown to depend on the exit slit width and the speed of recording, and the review finally mentions the question of reproducibility of data and gives a comparison between the photographic method and the photoelectric. S.T.Henderson

535.375.54

4333. VIBRATION SPECTRA OF FLUOSALTS OF ZINC HYDRATES. J.P.Mathieu, H.Poulet and R.Machiroux.
J. Phys. Radium, Vol. 17, No. 2, 122-3 (Feb., 1956). In French.

The Raman and infrared spectra of crystals of the isomorphous fluosalts of zinc (MF_6) [$Zn(OH_2)_6$], where M = Si, Sn, Ti, Zr, are interpreted. The fundamental frequencies of the MF_6 group have been determined and the effects of the crystalline symmetry and of the electronic structure of the element M are discussed. G.I.W.Llewelyn

535.375.54

4334. THE RAMAN SPECTRUM OF NAPHTHALENE. J.Brandmüller and E.Schmid.
Z. Phys., Vol. 144, No. 4, 428-48 (1956). In German.

The Raman spectrum of powdered naphthalene excited by 4358 and 4047 A has been photographed. The frequencies and normal co-ordinates are calculated on the basis of two models, one with the force constants of benzene and the other with force constants modified so that the eigen frequencies of the model approach more closely those of the measured spectrum. W.Good

535.39

4335. MEASUREMENT OF THE REFLECTIVITIES, IN THE FAR ULTRAVIOLET, OF EVAPORATED LAYERS OF TANTALUM, TUNGSTEN AND ZIRCONIUM. D.Fabre and J.Romand.
C.R. Acad. Sci. (Paris), Vol. 242, No. 7, 893-6 (Feb. 13, 1956). In French.

Measurements were made over the wavelength range 1100-1700 A. All three metals produced layers with reflection coefficients between 20 and 40%. The reflectivity of tungsten layers was observed to fall to 10-20% with exposure to air over a period of 3 months. It is suggested that layers of all three materials could be useful mirrors in this wavelength region. D.G.Avery

535.39

4336. MEASUREMENT OF REFLECTING POWER IN THE FAR ULTRAVIOLET OF SILICON FILMS EVAPORATED IN VACUO. S.Kandare and D.Fabre.
C.R. Acad. Sci. (Paris), Vol. 242, No. 9, 1150-2 (Feb. 27, 1956). In French.

Measurements were made of the reflecting power as a function of relative film thickness t with radiations $1100 < \lambda < 1700$ A. At the longer of these wavelengths, the reflectivity rises with t to a maximum, then sharply drops, and then rises to approach values obtained with the solid element. R.A.Weale

535.39

4337. A NEW LAMPROMETER. B.Persoz.
Rev. Opt., Vol. 34, No. 11, 592-5 (Nov., 1955). In French.

Describes an apparatus for rapid and convenient measurement of gloss of surfaces; a pencil of light of angular diameter about 3° falls at an angle of 60° to the normal on a standard

surface, and the reflected light is used to illuminate one half of the field of view of a telescope; light from the same source (a metal filament lamp in this case) also falls on the surface under test, and the reflected light illuminates the other half of the field of view. A grey wedge in one or other beam is adjusted until both fields of view appear equally bright; the reading of the wedge is then a measure of the ratio between the reflection factors under the particular conditions used. A precision of 2% is claimed. It is conceded that similar forms of the apparatus but using different values for the beam width and the angle of incidence give different results, i.e. gloss has not been reduced to a single numerical measure.

N.Corcoran

535.39

4338. THE TEMPERATURE DEPENDENCE OF THE REFLECTIVITY OF Cu, Ag, Au, Al AND Ni. D.Heinze.
Z. Phys., Vol. 144, No. 5, 455-75 (1956). In German.

A new multiple reflection method is described by means of which the reflectivity (R) of the above metals was measured between −150 and +100° C with light of wavelengths λ lying between 406 and 578 mμ. n and k were measured at room temperature. There is no temperature effect of the free electrons on R in Cu, Au, Al or Ni. At long λ, Ag shows an increase in R as the temperature is reduced. This is ascribed to the effect of free electrons. These data are in general agreement with predictions of the theory of the anomalous skin effect.

R.A.Weale

535.417

4339. ON THE MEASUREMENT OF OPTICAL PATH LENGTHS THROUGH THE SIMULTANEOUS EMPLOYMENT OF MONOCHROMATIC AND WHITE LIGHT INTERFERENCE EFFECTS. K.J.Hakoila.
Ann. Univ. Turku. A, Vol. 18, No. 3, 18 pp. (1955). In German.

The advantages of combining white light fringes and monochromatic fringes in an interferometric system are discussed. The procedure can be used both for fringes of equal thickness and for fringes of equal inclination. The interferometric system described is a Michelson interferometer with two pairs of compensating wedges in each arm. The procedure is discussed in detail. In the method used white light and helium light are combined. The fringe system is secured by crossing with a spectrograph and one obtains a form of channelled fringes and a series of monochromatic line fringes which can be analysed.

S.Tolansky

535.417

4340. A MACHINE FOR MEASURING INTERFERENCE FRINGES. Y.Grimod.
Rev. Opt., Vol. 34, No. 10, 509-11 (Oct., 1955). In French.

An automatic photoelectric device is described which computes the positions of interference fringes automatically, by means of a photocell. The fringes are then counted on an automatic computing machine. The system has a capacity for counting up to lengths of 100 mm.

S.Tolansky

535.417

4341. THE USE OF THIN FILMS IN INTERFEROMETRY. F.Abelès.
Rev. Opt., Vol. 34, No. 12, 636-9 (Dec., 1955). In French.

A review of the use of thin films for increasing reflecting coefficients and for the production of interferometric filters. A general survey of the reflectivity, transmissions and absorptions given by multilayers is included. A review is given of data available for the infrared and the ultraviolet. The effective phase-change on reflection is discussed.

S.Tolansky

535.417 : 531.715

4342. MEASUREMENT OF LENGTH BY INTERFERENCE. J.Terrien.
Rev. Opt., Vol. 34, No. 10, 498-509 (Oct., 1955). In French.

A survey is given of the methods used at the International Bureau of Weights and Measures at Paris for the evaluation of lengths by interferometry in terms of light waves. Familiar metrological techniques are surveyed and in addition the phase effects due to phase change on reflection at metal surfaces is discussed in detail. Transfer of lengths from end standards to line standards is discussed in detail, especially in the evaluation of lengths of the order of one metre. Twenty-six references are given.

S.Tolansky

535.417 : 531.715

4343. INTERFERENCE COMPARATOR OF THE TEST LABORATORY OF THE CONSERVATOIRE NATIONAL DES ARTS ET MÉTIERS. J.J.Hunzinger.
Rev. Opt., Vol. 34, No. 10, 512-19 (Oct., 1955). In French.

An interferometric circuit is described which is a polygonal variant of the Michelson interferometer. With it two length standards can be compared. The method of adjustment is described in detail, and the manipulation and performance surveyed. Standard gauges are examined with this system and comparisons are made.

S.Tolansky

535.417 : 531.787.5

4344. INTERFEROMETRIC MEASUREMENTS OF THE SMALL DEFORMATIONS OF A MEMBRANE APPLIED TO THE MEASUREMENT OF HIGH PRESSURES. G.Soudain.
Rev. Opt., Vol. 34, No. 10, 519-24 (Oct., 1955). In French.

The advantages of using an optical system are discussed. Interferometry is considered to be an ideal amplification system for revealing small displacements of a membrane. The membrane is matched against a concave lens and fringes are produced between the two surfaces. Pressures of the order of 600 kg per cm^2 can be evaluated.

S.Tolansky

535.417 : 535.822.17

4345. THE MEASUREMENT OF PHASE CHANGE IN THIN ABSORBING FILMS USING A POLARIZATION INTERFEROMETER. S.Lowenthal.
Rev. Opt., Vol. 34, No. 12, 632-5 (Dec., 1955). In French.

The measurement of phase change by interferometry leads to difficulties with absorbing materials, owing to the loss in fringe contrast. The phase films used in microscopy are often absorbing and it is necessary to measure the phase change with precision. It is shown how such a phase change can be measured by using the polarization interferometer of the Françon type. The theory is worked out for the Fabry—Perot interferometer, for Young's fringes and for the three-slit system of Zernicke as well as for the Françon white-light method of observing transparent objects.

S.Tolansky

535.417 : 539.213.2

4346. THE MEASUREMENT OF FAULTS IN HOMOGENEITY OF GLASS BY IMMERSION WITH A THIN FILM. A.Arnulf and M.Cagnet.
Rev. Opt., Vol. 34, No. 12, 639-45 (Dec., 1955). In French.

An interferometric method is described for studying the absence or lack of homogeneity in glass. The glass plate under examination is placed between two optical flats and contacted to these with an immersion fluid whose refractive index is close to that of the glass material. Interference fringes between the two flats reveal the defects in homogeneity in the glass plate placed between them. The experimental technique is described in detail. In particular, mechanical details are given for the method of securing parallelism between the two outer flats which have the glass plate between them. The system described is mechanically stable.

S.Tolansky

535.42

4347. DISTANT DIFFRACTED LIGHT AND THE ASSESSMENT OF IMAGES. E.H.Linfoot; P.M.Duffieux.
Rev. Opt., Vol. 34, No. 12, 617-31 (Dec., 1955). In French.

Criteria of image quality based upon the radius of gyration of the intensity distribution in the diffraction image of a point object have met difficulties due to the excessive contribution of the distantly diffracted light. A modified method due to

Lansraux is shown to hold good only for certain special cases. The analysis is extended to deal with off-axis images and it is shown that the resulting assessment is substantially identical with that by means of the radius of gyration of the corresponding ray-theoretical image. In a note, P.M.Duffieux comments on the views credited to him by Linfoot. R.W.Fish

535.43

4348. THEORY OF SCATTERING BY AN INHOMOGENEOUS SOLID POSSESSING FLUCTUATIONS IN DENSITY AND ANISOTROPY. M.Goldstein and E.R.Michalik.
J. appl. Phys., Vol. 26, No. 12, 1450-7 (Dec., 1955).

The theory of Debye and Bueche for the scattering of light by an amorphous solid is extended to the case where fluctuations in anisotropy as well as density are considered. A generalized correlation function is defined, which gives the probability of a simultaneous occurrence of fluctuations in polarizability in two volume elements a distance r apart. The fluctuations are specified by the magnitudes of the polarizabilities and the directions of the optic axes. The correlation function is assumed to depend on r, on the angle between the axes of the fluctuations, and on the angle giving the position of the second element with respect to the optic axis of the first. The intensities of the horizontal and vertical components of the scattered light are expressed as integrals over the correlation function of explicit functions of r and the two angles. From the initial slopes and intercepts of the intensities plotted against $\sin^2(\theta/2)$ where θ is the scattering angle, one can obtain average values and average dimensions of the fluctuations, and a measure of the extent to which fluctuations in density and anisotropy are correlated. The theory is applicable to glasses, gels and liquid crystals. A.

535.43

4349. SCATTERING OF POLARIZED LIGHT BY MAGNESIA. D.Blet-Talbot.
Rev. Opt., Vol. 34, No. 11, 579-91 (Nov., 1955). In French.

Polar curves of the reflectivity are measured photoelectrically for a parallel beam of plane-polarized light, incident at various angles. The results depend on (1) the magnesium ribbon used for preparing the surface and (2) the age of the film. G.F.Lothian

535.43 : 534.23

BRILLOUIN COMPONENTS IN LIGHT SCATTERING IN RELATION TO SOUND ABSORPTION. See Abstr. 3573

535.434/.435

4350. ON THE QUESTION OF THE CORRECT VALUES FOR RAYLEIGH'S RATIO. D.K.Carpenter and W.R.Krigbaum.
J. chem. Phys., Vol. 24, No. 5, 1041-8 (May, 1956).

Rayleigh's ratio values for benzene, toluene, and a toluene solution of the Cornell polystyrene were determined by absolute transverse scattering measurements. Use of a diffuser in the determination of the intensity of the primary beam is superior to direct measurement from the point of view of both random and systematic errors. Both these absolute measurements, and relative measurements on two polystyrene fractions of known number-average molecular weight, confirm the 'high' absolute scattering values. There exists a second set of absolute values, some recently determined, which is 40% lower. Likely sources of error in these measurements are pointed out. A.

535.51

4351. A COMPENSATOR FOR THE MEASUREMENT OF OPTICAL PHASE DIFFERENCES IN HIGH POLYMERS AND CRYSTALS. W.Voigt.
Z. angew. Phys., Vol. 8, No. 2, 75-81 (1956). In German.

An instrument is described which is made up from two units. One unit consists of a polarizing prism P and an analysing prism A, between which is a modified De Forest Palmer compensator C (see Phys. Rev., Vol. 17, 409, 1921 and Abstr. 1218/1948). Light passes in turn through P, C and A and then enters a photomultiplier unit. A is rotated rapidly about its visual axis. The second unit is identical with the first except that the compensator C is replaced by the material under test. The two units are set to give the same output by adjustment of C, from which the phase difference is found. The theory is presented together with full constructiona details of the apparatus. Some measurements made with the instrument are given: it is stated that the sensitivity is 5×10^{-6}. 2π. H.G.Jerrard

535.55

4352. A NEW METHOD OF EVALUATION FOR PLANE PHOTOELASTICITY. H.Bufler.
Z. angew. Phys., Vol. 8, No. 3, 139-41 (1956). In German.

The theory is presented of an approximate method which utilizes the isochromatic and isocline lattices. An example is given which gives results which compare favourably with th rigorous solution. H.G.Jerrard

535.568

4353. METHOD AND APPARATUS FOR THE IMMEDIATE SEPARATION OF THE STRESSES IN OBLIQUE POLARIZED LIGHT. P.Acloque.
Rev. Opt., Vol. 34, No. 11, 553-74 (Nov., 1955). In French.

Normally the measurement of plane stresses using polarized light utilizes a beam normal to the stress plane. Analysis of the beam gives the difference p – q of the principal stresse but not the separate values. The theory is given of the case in which light incident obliquely is used. Two additional relationships between p and q are obtained in terms of two measurable parameters, the angle of incidence and the azimuth of the plan of vibration. These enable p and q to be found separately even in an isotropic zone. This analysis is particularly useful with the help of total reflection of the beam on the second face of the sample. An apparatus, called a clino-polariscope, is described and examples of the method of deducing the results given. H.G.Jerrard

535.7

PHYSIOLOGICAL OPTICS. VISION. See under "Medical science. Human physiology". Decimal classification 612.84

535.822.17 : 532.525.51 : 533.6

APPLICATION OF PHASE CONTRAST TO THE STUDY OF GAS FLOWS. See Abstr. 3550

535.88

4354. HIGH EFFICIENCY MICROWAVE EXCITATION OF LIGHT SOURCES. A.T.Forrester, R.A.Gudmundsen and P.O.Johnson.
J. Opt. Soc. Amer., Vol. 46, No. 5, 339-42 (May, 1956).

An electrodeless discharge tube was mounted as a section of the inner conductor of a tuneable length of coaxial line. This made possible essentially perfect matching between the oscillator and the light source tube and permitted operation in a cavity of small diameter, a feature of particular importance where the light source needs to run between the poles of an electromagnet. To avoid the wastage of power incurred when an attenuator is placed between the oscillator and the load, the oscillator was protected by a cutoff relay activated by reflected power. The maximum intensity obtained for the Hg 5461 A line was 0.025 watt/cm^2/steradian under conditions for which the line, although wider than 10^{10} c/s, looked sharp when observed visually through a spectroscope. Under conditions for which the width was 8×10^9 c/s an intensity of 0.004 watt/cm^2/steradian was observed. A

HEAT 536

536.212.2 : 537.311.31 : 536.48

4355. THERMAL AND ELECTRICAL CONDUCTIVITIES OF THE ALKALI METALS AT LOW TEMPERATURES.
D.K.C.MacDonald, G.K.White and S.B.Woods.
Proc. Roy. Soc. A, Vol. 235, 358-74 (May 8, 1956).

Measurements of the thermal and electrical conductivities of very pure lithium, sodium, potassium, rubidium and caesium have been made down to temperatures as low as 2°K. The respective resistivities, W and ρ, may be written as the sum of an impurity resistance (W_o, ρ_o) and a so-called "ideal" component (W_i, ρ_i) due to scattering by the thermal vibrations of the lattice. The terms in the thermal resistivity may be represented by $W_\rho = A/T$ and $W_i = BT^n$ for $T \leq \theta/10$, where $n \cong 2$ and $A = (\rho_o/2.45) \times 10^8$ cm deg.^{2} W.$^{-1}$. Current theory predicts that the quantity $C \equiv B\theta^2/W \propto N^{2/3}$ should be constant, where N is the number of free electrons per atom and W is the measured high-temperature resistivity. Taking N = 1, the present experiments yield $C \cong 18 \pm 4$. The electrical resistance may be written $\rho = \rho_o + \beta T^m$ for $T < \theta/10$ with $m \cong 5$ except for sodium, where, below 8°K, m is found to increase to 6. The theoretical relationships which exist between the low-temperature "ideal" resistivities and those at higher temperatures are discussed in conjunction with the measured values. It is concluded that with the existing theories, no common adjustment of θ can give satisfactory agreement of theory with experiment. A new simple semi-empirical expression is put forward for W_i which provides rather good agreement with experiment. A.

536.42

4356. CRITICAL COEFFICIENT, DENSITY OF SATURATED VAPOUR, AND LATENT HEAT OF EVAPORATION. INVESTIGATIONS ON THE WIDENING OF THE THEOREM OF CORRESPONDING STATES. III. L.Riedel.
Chem.-Ingen.-Tech., Vol. 26, No. 12, 679-83 (Dec., 1954). In German.

For Pt II, see Abstr. 10842 (1954). The critical coefficient $k = RT_c/p_cV_c$ is expressed with a close approximation by the empirical formula $k = 3.72 + 0.26\,(\alpha_k - 7)$, where α_k is the "critical parameter" (see also correlations established in previous Pts). The compressibility, temperature coefficient of vapour pressure, and molal heat of evaporation are given in tables as functions of reduced temperature and the critical parameter. The author proposes an equation for calculating the entropy of evaporation at the normal boiling-point.
F.Lachman

536.42

4357. COMPRESSIBILITY, SURFACE TENSION AND THERMAL CONDUCTIVITY IN LIQUID STATE. INVESTIGATIONS ON THE WIDENING OF THE THEOREM OF CORRESPONDING STATES. IV. L.Riedel.
Chem.-Ingen.-Tech., Vol. 27, No. 4, 209-13 (April, 1955). In German.

A dimensionless magnitude (isothermal compressibility x critical pressure) is shown to be another universal function of reduced temperature and pressure. Relationships are derived for surface tension, parachor (simplified), surface enthalpy, heat of evaporation and heat conductivity, and the reduced and critical temperatures and pressures. F.Lachman

536.421.1 : 539.89

4058. THE LINDEMANN AND GRÜNEISEN LAWS.
J.J.Gilvarry.
Phys. Rev., Vol. 102, No. 2, 308-16 (April 15, 1956).

The Lindemann assumption of direct contact of neighbouring atoms at fusion is replaced by the criterion that melting occurs when the root-mean-square amplitude of thermal vibration reaches a critical fraction ρ, presumed the same for all isotropic monatomic solids, of the distance of separation of nearest-neighbour atoms. The Debye–Waller theory of the temperature dependence of the intensity of Bragg reflection of X-rays is used, without further assumptions, to derive a generalized Lindemann law. In contrast to the Lindemann form, all physical quantities involved in this formulation are evaluated at the fusion point, and departure of the average energy of an atomic oscillation from the equi-partition value is taken into account by the quantization factor of the Debye–Waller theory. If the Grüneisen constant γ_m of the solid at fusion is evaluated by its definition from the Debye frequency of the solid, use of the generalized Lindemann law and Clapeyron's equation permits one to express γ_m in terms of the bulk modulus of the solid at melting and the latent heat and volume change of fusion. By means of Grüneisen's law applied to the solid at fusion, γ_m can be expressed likewise in terms of the corresponding bulk modulus, thermal expansion, volume, and heat capacity at constant volume; the two evaluations of γ_m connect the Lindemann and Grüneisen laws. These relations permit one to evaluate the slope and curvature of a fusion curve as functions of γ_m, and thus to express in terms of γ_m the conditions that a fusion curve be normal in the sense of Bridgman. Experimental fusion data on 13 cubic metals are used to evaluate the constant of proportionality (inversely proportional to ρ) in the Lindemann frequency; the values are reasonably constant. The corresponding values of ρ for Al and Cu show reasonable agreement with values deduced from X-ray intensity measurements. The average ρ seems significantly below values estimated by Grüneisen. Good agreement with the cubic metals is found for hexagonal close-packed elements, but not for elements with more complex lattices, in general. The two evaluations of the Grüneisen constant γ_m of the solid at fusion are shown to be in good agreement, experimentally, for 14 elements checked, but agreement fails for the elements Ga, Bi and Sb, which show abnormal fusion curves. A.

536.421.1 : 539.89

4359. GRÜNEISEN'S LAW AND THE FUSION CURVE AT HIGH PRESSURE. J.J.Gilvarry.
Phys. Rev., Vol. 102, No. 2, 317-25 (April 15, 1956).

The correction to Grüneisen's law corresponding to the effect of the electrons at high pressure is determined, on the assumption that the lattice contribution to the pressure is small, and that the equation of state of the solid can be approximated by results of the statistical Thomas–Fermi atom model for the electron pressure. The effect of a first-order temperature perturbation, for temperatures low in the sense of the model, is included in the Thomas–Fermi theory, but exchange is neglected. For temperatures subject to the restriction noted, but high enough so that the electronic contribution to the heat capacity dominates the lattice contribution, Grüneisen's law is valid as a formal relation on the Thomas–Fermi theory, with a physical reinterpretation of the proportionality constant which enters. The fusion curve under high compression is determined from a reformulation of the Lindemann law given previously, on the similarity assumption that the ratio of the amplitude of thermal vibration to nearest neighbour distance has the same value at high pressure as at low. The fusion temperature as a function of pressure is determined to zero order from results of the zero-temperature Thomas–Fermi theory, on the assumption that Poisson's ratio is independent of temperature and pressure. It is shown that the general temperature-perturbed Thomas–Fermi theory is adequate to determine the fusion curve on this model, except for the domain of large atomic number near the Fermi–Dirac limit of high pressure, for values of Poisson's ratio which are not relatively high. Exclusively of this domain, it is proved that the predicted fusion curve is normal in the sense of Bridgman, and is not in accord with the hypotheses of Tamman or of Schames. Fusion curves predicted for the alkali elements at high pressure are in accord with experimental results of Bridgman for low pressure, in the sense that the high-pressure curves show a rever-

sal of normal order with respect to atomic number of melting temperature in the alkali metal family, as postulated by Bridgman from extrapolation of the low-pressure curves. The theory presented yields a general method of determining the correc, tions, corresponding to the lattice contributions, in thermodynamic functions determined from the Thomas–Fermi model (the method is subject to a limitation on physical validity in the Fermi–Dirac limit of high pressure). A.

536.421.1 : 539.89

4360. EQUATION OF THE FUSION CURVE. J.J.Gilvarry.
Phys. Rev., Vol. 102, No. 2, 325-31 (April 15, 1956).

A generalization of the Lindemann law given previously is used in conjunction with the Murnaghan equation of state for a solid to derive a law of reduced states for fusion, valid for the case of classical excitation of the lattice vibrations at melting. If the bulk modulus and volume of the solid at fusion and the melting temperature are reduced by dividing the quantity in question by its corresponding value at the origin of the fusion curve, any reduced variable of this set can be expressed as a power of any other, with an exponent involving a constant appearing in the Murnaghan equation. It is shown that the ratio of the latent heat to the volume change of fusion obeys a similar law of reduced states, on the basis of an assumed form of the volume dependence of the Grüneisen parameter of the solid along the fusion curve. The constant appearing in the Murnaghan equation of state is interpreted physically in terms of an average Grüneisen parameter of the solid. The law of reduced states yields an immediate derivation of the empirical Simon equation for the fusion curve. For the alkali metals, it is shown that experimental values of the temperature exponent in the Simon equation are quantitatively compatible with the theoretical evaluation given, and, furthermore, that the theory can predict approximate values of the exponent, in practice. A.

536.421.1 : 539.89

4361. GRÜNEISEN PARAMETER FOR A SOLID UNDER FINITE STRAIN. J.J.Gilvarry.
Phys. Rev., Vol. 102, No. 2, 331-40 (April 15, 1956).

An evaluation of the Grüneisen parameter (or constant) from the equation of state of a solid has been obtained by Druyvesteyn and Meyering on the basis of the theory of finite strain. The result differs (by $-\frac{1}{3}$) from the corresponding evaluation on the Debye theory, as given by Lorentz and by Slater. The value of Druyvesteyn and Meyering is derived here without use of the formal theory of finite strain, and shown to correspond physically to a model of independent pairs of nearest-neighbour atoms, rather than to the Debye model of coupled atomic vibrations. This fact resolves a paradox raised by Dugdale and MacDonald in connection with an ideal harmonic solid, and ascribed by them to neglect of finite strain. The presence of a state of finite hydrostatic pressure, upon which elastic waves or pressure changes of infinitesimal amplitude are impressed, is taken into account explicitly by means of Murnaghan's theory of finite strain, to obtain the Grüneisen parameter, as evaluated from the equation of state, on the Debye model and for a Druyvesteyn–Meyering solid. The results are identical in the two cases with the corresponding values obtained without use of the formal theory of finite strain. Hence, no basis exists for the modification at finite pressure in the Grüneisen parameter from the Debye theory, as proposed by Dugdale and MacDonald. A comparison of average values over a relatively large number of elements, of Grüneisen constants as evaluated from Grüneisen's law and from the equation of state on the Debye model, shows excellent agreement at normal and at melting temperature. A.

536.423.15

4362. A NULL METHOD FOR THE MEASUREMENT OF LOW VAPOUR PRESSURES. O.Amsel and G.Wittwer.
Z. angew. phys., Vol. 8, No. 1, 20-4 (1956). In German.

Use is made of a sensitive diaphragm gauge permitting measurements from 2×10^{-4} mm Hg to atmospheric pressure, from room temperature to 200°C. Owing to the null method employed, the results are entirely independent of the nature of vapour molecules and the measurement procedure does not interfere with the attainment of equilibrium pressure. Measurements can also be made on solids. A.Gelbtuch

536.424

4363. NEW MODIFICATION OF SOLID NITROGEN.
C.A.Swenson.
J. chem. Phys., Vol. 23, No. 10, 1963-4 (Oct., 1955).

Preliminary results are given on the phase diagram of solid N, and the existence of a third solid phase is reported at low temperatures. The triple point of the three solid phases lies at 44.5°K and 4650 atm. The third phase probably has a close-packed structure. F.Lachman

536.44

4364. ON CRITICAL POINTS. P. van der Leeden.
Physica, Vol. 21, No. 9, 743-4 (Sept., 1955).

Lines and points of higher order occur in thermodynamics a higher-order point on a line of lower order always being the point of intersection of some transition lines. Singular points do exist however without any other transition line through the point, e.g. the critical point on a vapour-pressure curve. It is suggested that the term 'critical point' be restricted to any point where development with respect to the intensity parameters fails to be possible. The difference between the Curie point in ferromagnetics and the Néel point in antiferromagnetic is discussed. F.E.Hoare

536.46 : 535.33.03

FAR INFRARED EMISSION SPECTRUM OF FLAMES. ROTATIONAL SPECTRUM OF OH-RADICALS AND DETERMINATION OF FLAME TEMPERATURES. See Abstr. 3601

536.461 : 541.127

4365. FLAME PROPAGATION: THE RANDOM WALK OF CHEMICAL ENERGY. H.Eyring, J.C.Giddings and L.G.Tensmeyer.
J. chem. Phys., Vol. 24, No. 4, 857-61 (April, 1956).

A new approach to the theory of burning velocity is presented in which a flame front moves forward at a rate determined by the random walk of chemical (potential) energy. The flame velocity is determined by the value of n which is a collision rate divided by a reaction rate, both determined at the point of maximum reaction velocity. The comparison between theoretical and experimental flame velocities is given for cases in which the chemical kinetics are quite well understood. Empirical activation energies for reaction are given for certain hydrocarbon flames. It is hoped that these may be useful in determining the important chemical processes in hydrocarbon flame-propagation. A.

536.48 : 536.631

4366. HEAT CAPACITIES OF THREE PARAMAGNETIC ALUMS AT LOW TEMPERATURES. D.G.Kapadnis.
Physica, Vol. 22, No. 3, 159-71 (March, 1956).

The heat capacities of potassium chromic alum, ferric ammonium alum and chrome methylamine alum have been measured in the liquid helium and hydrogen temperature ranges by the method of low temperature adiabatic calorimetry. The specific heats between 1 and 4.2°K can be represented by the relations: $c_p = 0.135/T^3 + 4.11 \times 10^{-3}\ T^3$ J/mole-deg, $c_p = 0.112/T^3 + 3.52 \times 10^{-3}\ T^3$ J/mole-deg, and $c_p = 0.162/T^3 + 3.91 \times 10^{-3}\ T^3$ J/mole-deg. for the respective alums. The Debye characteristic temperature and the crystalline splitting parameter have been computed for each alum. The values of the former are 77.9°K, 82.3°K and 79.2°K and of the latter 0.247°K, 0.192°K and 0.273°K respectively for CrK-, $FeNH_4$ and $CrCH_3NH_3$ alum. These results are compared with those of other investigators. The observed deviations in the hydrogen temperature region are reported. A.

536.48

367. COLLECTIVE AND INDIVIDUAL DEGREES OF FREE-OM IN HELIUM II. W.Brenig.
. Phys., Vol. 144, No. 5, 488-508 (1956). In German.
A decomposition of the Hamiltonian operator for a real ose gas into collective and individual parts is effected and he results studied. A discontinuity in the specific heat is ound as a consequence of a Bose—Einstein condensation for he individual part. P.T.Landsberg

536.48 : 532.137

368. NEW METHOD FOR MEASURING THE ABSOLUTE ISCOSITY OF LIQUID HELIUM II. H.H.Kolm and M.A.Herlin. hys. Rev., Vol. 102, No. 3, 607-13 (May 1, 1956).
A new type of static viscometer for use in liquid helium II as been developed in which the inner cylinder is suspended within a rigidly fixed, coaxial, outer cylinder by a servomechanically controlled magnetic bearing of the type used by Beams and others in vacuum ultracentrifuges. The inner cylinder is accelerated electromagnetically and the absolute viscosity of the medium is determined from the deceleration observed when it is permitted to coast freely. Bearing friction is negligible, and there is no inherent lower limit to the speed of the rotor. Reproducible viscosity values were obtained in gaseous helium. In liquid helium II damping proportional to 1/TS caused by thermomechanical flow, induced by eddy-current heating, was observed. This effect was reduced considerably by elaborate precautions to isolate the apparatus from ground vibrations; further improvement would require more favourable location of the apparatus. At higher speeds, the anomalous behaviour reported elsewhere was again observed. The absolute viscosity was found to increase discontinuously to a higher value as the speed was increased. The observation is reproducible qualitatively, but, because of vibrations, not quantitatively. Attention is called to a possible analogy between this phenomenon and the observation of stable vorticity in water. A.

536.48 : 536.63

4369. SPECIFIC HEAT OF DILUTE SOLUTIONS OF He^3 IN LIQUID He^4. P.B.Linhart and P.J.Price.
Physica, Vol. 22, No. 1, 57-60 (Jan., 1956).
The specific heat—concentration curve is derived from the experimental saturation pressures and supplementary data by means of thermodynamical relations. Comparison with direct measurements shows good agreement between 1.2 and 1.9°K; at higher temperatures there is a marked discrepancy. By means of available data a hypothesis is put to the test according to which the ratio specific heat/concentration would be independent of the temperature. It is found that at temperatures lower than 1.4°K the hypothesis is compatible with observations but is definitely false at higher temperatures.
R.Eisenschitz

536.48 : 536.632 : 536.75

4370. SPECIFIC HEAT AND ENTROPY OF LIQUID He^3. B.K.Agarwal.
Curr. Sci., Vol. 24, No. 12, 405-6 (Dec., 1955).
The specific heat is expressed as a function of the absolute temperature by a three-term formula consisting of a non-vanishing constant, a first-power and a third-power term. The parameters are fitted to specific heat measurements. The entropy is then derived as a function of the temperature. The calculated entropy agrees with experiment in the interval 0.5-2.5°K but would be $-\infty$ if extrapolated to absolute zero.
R.Eisenschitz

536.48 : 539.185.7

TRANSMISSION OF SLOW NEUTRONS BY LIQUID He^4.
See Abstr. 4030

536.483

4371. ON THE PRODUCTION OF COLD BY MEANS OF SOLAR RADIATION. F.Trombe and M.Foëx.
C.R. Acad. Sci. (Paris), Vol. 242, No. 8, 1000-3 (Feb. 20, 1956). In French.
A description, and diagram, of an ammonia refrigerator in which the gas is liberated from solution using solar energy concentrated by a parabolic-cylindrical mirror. A prototype has produced ice at the rate of 1 kg per hr per square metre of collecting surface. Several advantages are claimed for the arrangement chosen, one being that the cold is produced without water circulation which is of importance in arid countries.
F.E.Hoare

536.631 : 537.312.62

4372. ATOMIC HEATS OF NORMAL AND SUPERCONDUCTING VANADIUM. W.S.Corak, B.B.Goodman, C.B.Satterthwaite and A.Wexler.
Phys. Rev., Vol. 102, No. 3, 656-61 (May 1, 1956).
The atomic heats were determined from just above the transition temperature, $T_c = 5.03°K$, down to 1.1°K. After corrections to the 1948 temperature scale had been made, the normal state atomic heat could be represented by $C_n = \gamma T + (12/5)\pi^4 R(T/\Theta)^3$, with $\gamma = (9.26 \pm 0.03) \times 10^{-3}$ joule $mole^{-1}$ deg^{-2} and $\Theta = 338 \pm 5°K$. The entropy difference, $S_n - S_s$, between the normal and superconducting states, extrapolated to 0°K, was found to vanish, in accordance with the third law of thermodynamics. The critical field values deduced from $S_n - S_s$ gave $H_o = 1310$ oersteds; at higher temperatures they were in agreement with initial penetration fields previously reported. The most interesting result was that below about $0.7T_c$ the electronic contribution to the atomic heat of the metal in the superconducting state could be represented by an exponential expression of the form $C_{es}/\gamma T_c = ae^{-bT_c/T}$ with a = 9.17 and b = 1.50; such an exponential relation is consistent with a single-electron model of a superconductor involving a gap of the order of kT_c per electron in the spectrum of available energy levels. A.

536.631 : 537.312.62

4373. ATOMIC HEATS OF NORMAL AND SUPERCONDUCTING TIN BETWEEN 1.2° AND 4.5°K. W.S.Corak and C.B.Satterthwaite.
Phys. Rev., Vol. 102, No. 3, 662-6 (May 1, 1956).
Atomic heat measurements revealed that the electronic contribution to the atomic heat in the superconducting state, C_{es}, could be represented below about $0.7T_c$ by the same exponential expression found applicable to vanadium: $C_{es}/\gamma T_c = ae^{-bT_c/T}$, with a = 9.17 and b = 1.50. The deduced curve of critical field v. temperature was in good agreement with H_c - T curves reported from magnetic measurements. The critical field extrapolated to the absolute zero, H_o, was 303.4 oersteds and the transition temperature was 3.722°K. Below 2.5°K the normal atomic heat could be represented by the Sommerfeld—Debye expression with $\gamma = 1.75 \times 10^{-3}$ joule $mole^{-1}$ deg^{-2} and $\Theta = 195.0°K$; above 2.5°K deviation from this expression indicated that Θ decreased with increasing temperature. A.

THERMODYNAMICS 536.7/.8

536.7

4374. A STUDY OF POSTULATES: THE "THERMODYNAMIC" DERIVATION OF THE ADIABATIC GAS LAW. D.Shanks.
Amer. J. Phys., Vol. 24, No. 5, 352-4 (May, 1956).
The adiabatic gas law, $pv^\gamma = const$, is usually derived in thermodynamic textbooks as if it were a consequence of the first law of thermodynamics. It is shown here that the first law, and other assumptions made, are really irrelevant. These "thermodynamic" derivations are then analysed in order to clarify the nature of the irrelevancies. A.

536.7 : 530.162

ON THE QUANTUM THEORETICAL DERIVATION OF CLASSICAL PHYSICS. STATISTICAL MECHANICS AND THERMODYNAMICS. See Abstr. 3507

ELECTRICITY 537

537.123

4375. THE DETECTION OF THE ANTIPROTON. G.Lüders. Naturwissenschaften, Vol. 43, No. 6, 121-3 (1956). In German.

ELECTROSTATICS. DIELECTRICS 537.2

537.213

4376. POTENTIAL OF A UNIFORMLY CHARGED DISK. E.Durand.
C.R. Acad. Sci. (Paris), Vol. 242, No. 7, 887-9 (Feb. 13, 1956). In French.

A continuation of previous work. A general expression for the potential at any point outside the disk is given.

C.G.Morgan

537.221

4377. WORK FUNCTION OF LEAD. P.A.Anderson and A.L.Hunt.
Phys. Rev., Vol. 102, No. 2, 367-8 (April 15, 1956).

The work functions of twelve lead surfaces have been determined by measurement of their contact differences of potential with respect to barium reference surfaces of known work function. The lead surfaces were prepared by subjecting Hilger's spectroscopic lead to intensive outgassing followed by fractional distillation, redistillation, and deposition on glass targets. The barium surfaces were prepared by a similar standardized technique which yields surfaces constant and reproducible to 0.01 eV. Measurement was by the electron beam method, and the time lapse between deposition and measurement of a fresh surface was five seconds. The contact difference of potential for Ba–Pb is found to be 1.48 ± 0.01 V. The work function of lead, referred to a Ba work function of 2.52 eV, is then 4.00 ± 0.02 eV. No drift of work function exceeding 0.01 eV was found on ageing. Since the minimal time required for deposition of a monolayer of gas is large with respect to the metal deposition-measurement interval, it is concluded (1) that the film of gaseous contaminants absorbed by a lead surface during equilibration is insufficiently dense to affect the work function, and (2) that the observed work function is probably characteristic of clean lead. A.

537.226.2

4378. THE PROBLEM OF THE DIELECTRIC CONSTANT OF BARIUM TITANATE. I.P.Kozlobaev.
Dokl. Akad. Nauk SSSR, Vol. 104, No. 3, 387-8 (1955). In Russian.

Specimens of Curie temperature 127° showed that ϵ is independent of mechanical pressures up to 400 kg/cm². After this it falls with increasing pressure, to reach a constant value at more than 2000 kg/cm² which is maintained up to mechanical failure. The relation is reversible down to ~ 1600 kg/cm², then the reversal curve is above the direct curve. Further stress cycles approach the reversal curve to the direct curve which is reached again at the fourth cycle.

Electrical Research Association

537.226.2 : 537.228.1 : 539.32

4379. ELASTIC, PIEZOELECTRIC, AND DIELECTRIC CONSTANTS OF POLARIZED BARIUM TITANATE CERAMICS AND SOME APPLICATIONS OF THE PIEZOELECTRIC EQUATIONS. R.Bechmann.
J. Acoust. Soc. Amer., Vol. 28, No. 3, 347-50 (May, 1956).

A complete set of the elastic, piezoelectric, and dielect constants of polarized barium titanate ceramics is presented The various electromechanical coupling factors, as derived from the piezoelectric equations, and their numerical values are also given. The determination of the elastic piezoelectri constants using the resonant method applied to small bars, square plates, and disks is discussed.

537.226.2 : 537.311.32 : 548.

4380. EFFECT OF Fe_2O_3 ON THE PROPERTIES OF BARIUM TITANATE SINGLE CRYSTALS. A.Nishioka, K.Sekikawa and M.Owaki.
J. Phys. Soc. Japan, Vol. 11, No. 2, 180-1 (Feb., 1956).

The Curie point falls linearly from 120 to 15° C when the atomic percentage of iron is increased from 0.2 to 5. At roon temperature the crystal changes from tetragonal to cubic symmetry as the iron content is increased to 5%. The variati of activation energy with iron content is calculated from d.c. conductivity measurements between 20 and 150° C. $[\sigma = \sigma_0 \exp(-\Delta E/2kT)]$. Maximum resistivity occurs with 0.2% iron, but then the temperature variation is complex, du perhaps to coexistence of equal numbers of electrons and hol so that ΔE cannot be estimated. J.H.Maso

537.226.

4381. ACTION OF PLASTICIZERS ON THE ACTIVATION ENERGIES OF CERTAIN DIELECTRICS. P.Caillon and E.Groubert,
C.R. Acad. Sci. (Paris), Vol. 242, No. 10, 1313-14 (March 5, 1956). In French.

See Abstr. 2068 (1956). The addition of 10% dioctyl phthalate to polyvinylchloride reduces the activation energies for Debye-type dielectric loss from 120 to 54, for Maxwell–Wagner loss from 23 to 18 and for d.c. conduction from 64 to 28 kcal/mole; related reductions occur for other concentrations. D.H.Whiffe

537.226.

4382. DIELECTRIC PROPERTIES OF ETHYL ACETATE IN THE ULTRA HIGH FREQUENCY REGION.
K.V.Gopala Krishna.
Curr. Sci., Vol. 25, No. 2, 49-50 (Feb., 1956).

Using a short-circuited coaxial cable filled with methyl acetate, ϵ' and tan δ were measured at 800 Mc/s from −60 to +30° C and from 400 to 900 Mc/s at +30° C. D.H.Whiffe

537.226.

4383. DIELECTRIC LOSSES IN IONIC DIELECTRICS IN STRONG ELECTRIC FIELDS. L.E.Gurevich and V.N.Gribov Zh. éksper. teor. Fiz., Vol. 29, No. 5(11), 629-36 (1955). I Russian.

Skanavi introduced the concept of dielectrics comprisin ions which may exist in the crystal lattice in two equilibrium positions near to each other, and investigated the losses due to transitions of these ions between the two equilibrium positions in weak electric fields. The paper investigates the dielectric losses caused by the same mechanism in the case strong fields. At low frequencies, losses rise with frequenci at high frequencies they are frequency-independent.

Electrical Research Associatio

537.226.3

4384. MICROWAVE ABSORPTION IN COMPRESSED GASES; SATURATED HYDROCARBONS. A.A.Maryott and G.Birnbaum.
J. chem. Phys., Vol. 24, No. 5, 1022-6 (May, 1956).

Sensitive resonant cavity techniques were used to searc for dielectric loss in the lower members of the saturated hydr carbon series, C_1 through C_8, at several frequencies in the range 2 to 24 kMc/s. No detectable loss was found in methane

$\tan\delta < 8 \times 10^{-7}$) or ethane ($\tan\delta < 4 \times 10^{-7}$) up to the highest pressures examined, 69 and 36 atm, respectively. Significant loss attributable to the presence of small permanent dipole moments was found in propane, isobutane, and isopentane. The results for isobutane, which show nonresonant or Debye type absorption characteristic of a symmetric top inversion spectrum having "zero" frequency, lead to an accurate evaluation of the dipole moment, namely 0.132 D. The effective collision diameters for impacts governing the Debye relaxation in both isobutane and isopentane are larger than the kinetic collision diameters. A.

537.226.33.08

4385. ON THE DETERMINATION OF DIPOLE MOMENT AND RELAXATION TIME AT 3 cm. C.Radhakrishna Murty and D.V.G.L.Narasimha Rao.
Curr. Sci., Vol. 25, No. 24, 49 (Feb., 1956).

A waveguide reflection method is used to measure ϵ' and ϵ'' at 3 cm wavelength and the relaxation time and dipole moments in benzene solutions are derived therefrom for nitrobenzene and some ketones. D.H.Whiffen

537.226.8

4386. THE VARIATION WITH TEMPERATURE OF THE ELECTRIC STRENGTH OF POLYISOBUTYLENE SUBJECTED TO DISCHARGES. E.M.Hawley.
Rep. Brit. Elect. Res. Assoc., Ref. L/T290, 10 pp. (1953).

537.226.8 : 537.528

4387. ON THE BREAKDOWN FIELD STRENGTH IN DIELECTRIC LIQUIDS OF DIFFERENT MOLECULAR COMPOSITION. E.Musset, A.Nikuradse and R.Ulbrich.
Z. angew. Phys., Vol. 8, No. 1, 8-15 (1956). In German.

A comprehensive investigation of the electrical breakdown of a large number of dielectric organic compounds in various states of controlled purity. C.G.Morgan

537.228.1

4388. NEW METHOD OF MEASURING THE QUALITY FACTOR OF PIEZOELECTRIC CRYSTALS. H.Mayer.
C.R. Acad. Sci. (Paris), Vol. 242, No. 11, 1428-30 (March 12, 1956). In French.

A method is described for exciting the crystal at its resonant frequency for a period of about 1/100 sec and then allowing the vibrations to decay for a similar period. The decrement is observed with an oscilloscope and the quality factor, Q, is deduced from the expression

$$Q = \pi f T / 2.303 \log (E_0/E_1),$$

where f is the resonant frequency and T is the time for the amplitude to decay from E_0 to E_1. Using this method, the Q of beryllium sulphate cut parallel to the 100 face was 6700 in vacuo and 3300 in air at atmospheric pressure. H.J.H.Starks

ELECTRIC CONDUCTION. CURRENTS 537.3

537.311.1 : 537.32 : 536.212.2

4389. INFLUENCE OF EXCHANGE AND CORRELATION ON ELECTRON TRANSPORT IN METALS. F.J.Blatt.
Phys. Rev., Vol. 99, No. 6, 1735-6 (Sept. 15, 1955).

A result of the collective treatment of Bohm and Pines is that the dependence of electron energy ϵ on the wave vector ϵ differs from that for noninteracting free electrons. It follows that the expressions for those properties, such as conductivity and thermoelectric power, which depend on the relationship between ϵ and k must be suitably modified. Electrical and thermal conductivity are altered in the same manner, suffering slight changes because of changes of the density of states at the Fermi energy and of the relaxation time. The Wiedemann-Franz ratio remains unaltered. For the alkali metals the calculated thermoelectric power is reduced slightly below the free-electron value. The changes in both conductivity and thermoelectricity are too small to permit quantitative comparison with experiment. A.

537.311.31 : 536.212.2

THE ELECTRICAL CONDUCTIVITY OF SILVER-PALLADIUM AND SILVER-CADMIUM ALLOYS AT LOW TEMPERATURES. See Abstr. 3670

537.311.32 : 539.11

ELECTRICAL CONDUCTIVITY OF AROMATIC HYDROCARBONS. See Abstr. 3873

537.311.33

4390. THEORY OF THE HALL EFFECT IN IONIC SEMICONDUCTORS. M.I.Klinger.
Zh.éksper. teor. Fiz., Vol. 29, No. 4(10), 439-48 (1955). In Russian.

The Hall constant is calculated for ionic semiconductors in the approximation for weak bonds and also in the adiabatic approximation. The method of steady states is used, without reference to the kinetic equation. The results differ from those obtained by the latter, particularly for $N_- = N_+$, i.e. especially for semiconductors without impurities. For example, in polaron-type semiconductors, R is determined by the ratio of polarizabilities of electron and deficiency polarons.
Electrical Research Association

537.311.33

4391. SOME PROBLEMS OF THE MULTI-ELECTRON THEORY OF SEMICONDUCTORS. S.V.Vonsovskiĭ.
Zh. tekh. Fiz., Vol. 25, No. 12, 2022-9 (1955). In Russian.

The author discusses the difficulties of solving the complete wave equation (in Hamiltonians) of the multi-electron problem, even in the adiabatic approximation which is, moreover, physically unsuitable for the case of semi-conductors. He then investigates systematically the possibilities of using modern methods of quantum field theory (quantum theory of condensed systems). Particularly interesting is the polar-exciton model, being a generalization of the exchange model of a ferromagnetic dielectric and the single-electron model.
Electrical Research Association

537.311.33

4392. THEORY OF SEMICONDUCTORS WITH A ZONE OF IMPURITIES. A.G.Samoĭlovich and M.I.Klinger.
Zh. tekh. Fiz., Vol. 25, No. 12, 2050-60 (1955). In Russian.

The characteristics of the electron gas are considered in two cases: (1) in a metal with a narrow zone of conductivity; (2) in a semiconductor with an admixture zone. The chemical potential is calculated and investigated for both cases. Electrical conductivity and thermo-e.m.f. are also calculated, first, in relation to the population of the narrow zone and its reduced width, secondly, in relation to T. Experimental data and calculations are compared. Electrical Research Association

537.311.33

4393. THE INDIVIDUAL SEMICONDUCTOR. O.Madelung.
Z. Elektrochem., Vol. 60, No. 1, 7-13 (1956). In German.

General outline of basic semiconductor theory including band structure, density of states, free carrier concentrations, the application of the mass action principle, recombination centres and the concept of carrier lifetime. C.A.Hogarth

537.311.33 : 537.226

4394. THE STATE OF SOME PROBLEMS OF THE THEORY OF SEMICONDUCTORS AND DIELECTRICS AND DIRECTIONS OF THE FURTHER DEVELOPMENT OF THE THEORY. S.I.Pekar.
Zh. tekh. Fiz., Vol. 25, No. 12, 2030-43 (1955). In Russian.

A summary of the electrical, photoelectric and optical phenomena in electronic semiconductors and dielectrics, with the following sections: (1) phenomenological theory of semiconductors; (2) electron kinetics in the conductivity zone of a semiconductor; (3) theory of thermal (radiation-free) electron

transitions, and (4) of photo-transitions of electrons in semiconductors; (5) methods of calculating steady quantized states of a crystal. The bibliography refers particularly to papers characteristic of the present state of the theory and of the directions of its development.

Electrical Research Association

537.311.33 : 541.57

4395. CHEMICAL BOND IN SEMICONDUCTORS. F.Mooser and W.B.Pearson.
Phys. Rev., Vol. 101, No. 5, 1608-9 (March 1, 1956).

Investigation of a number of compounds and a survey of all known semiconductors suggests that it is useful to speak of a specific 'semiconducting bond' and to discuss its characteristics. Preliminary discussion centres on the occurrence of filled s and p subshells in at least one of any two atoms connected by such a bond and a rule for the concentration of valence electrons per molecule of the semiconductor is formulated which has provided a means for the successful prediction of semiconductivity in compounds from a knowledge of the stoichiometric formula and the valences of the constituent atoms. A more detailed account is to be published elsewhere.

W.Bardsley

537.311.33

4396. SCATTERING OF CARRIERS FROM DOUBLY CHARGED IMPURITY SITES IN GERMANIUM. W.W.Tyler and H.H.Woodbury.
Phys. Rev., Vol. 102, No. 3, 647-55 (May 1, 1956).

The effect of doubly-charged impurity sites on the mobility of carriers in Ge has been observed in both equilibrium and photoconductivity measurements. For equilibrium studies Zn-doped samples were used. Zn is a double-acceptor impurity in Ge, introducing levels at about 0.03 eV and 0.09 eV from the valence band. Studies of the magnitude of mobility indicate that the scattering cross-section for holes from doubly-charged Zn sites is approximately four times that for holes from singly charged Ga sites. For n-type Ge crystals containing Fe, Ni, Mn, or Zn impurity sites, charged doubly negative by compensation, high light-level photoconductivity experiments indicate that an increase in the steady-state free electron concentration is associated with a corresponding increase in mobility. This mobility increase is attributed to a decrease from two to one units at the sites of trapped holes. Its magnitude is consistent with a Z^2 dependence for charged impurity scattering. In heavily doped crystals, the mobility change represents an appreciable fraction of the conductivity change. On saturation of hole trapping (approximated in Fe- and Mn-doped samples), the concentration of trapped holes is observed to be approximately equal to the known double-acceptor impurity concentration. Thus hole trapping may be unambiguously identified with specific double-acceptor impurities. A.

537.311.33

4397. EXCESS NOISE SPECTRA IN GERMANIUM. F.J.Hyde.
Proc. Phys. Soc. B, Vol. 69, Pt 2, 242-5 (Feb., 1956).

Experiments with germanium filaments suggest that the observed noise frequency of spectrum in which the noise power varies as $1/f$ at low frequencies and as $1/f^2$ at high frequencies, with an intermediate range over about three decades where it varies as $1/f^{1.24}$, may be explained as due to fluctuations in carrier occupation of two recombination-centre levels of different energy and relaxation time. C.A.Hogarth

537.311.33

4398. THE POSSIBILITY OF PRODUCING P-N TRANSITIONS IN GERMANIUM BY IMPULSE HEATING. M.M.Bredov.
Zh. tekh. Fiz., Vol. 25, No. 12, 2104-11 (1955). In Russian.

The possibility of producing p–n transitions in germanium by thermal conversion under the effect of an electron impulse beam is considered. The related problem of the propagation of a thermal wave in a flat specimen is solved. The relations between the parameters of the electron beam and the width of t transition zone are determined in an approximation. The theo retical results are qualitatively confirmed by experiments.

Electrical Research Associati

537.311.33 : 538.6

4399. THERMO-MAGNETO-ELECTRIC EFFECTS IN INDIUM ANTIMONIDE. P.Aigrain, C.Rigaux and J.M.Thuill
C.R. Acad. Sci. (Paris), Vol. 242, No. 9, 1145-8 (Feb. 27, 1956). In French.

A theoretical and experimental investigation using InSb filaments of the transverse effects observed when a magnetic field is applied (as in the Hall effect) across a specimen in which there is a diffusion of both holes and electrons due to a thermal gradient along the specimen. C.A.Hogart

537.311.3

4400. RECOMBINATION RADIATION FROM InSb. T.S.Mc and T.H.Hawkins.
Phys. Rev., Vol. 101, No. 5, 1609-10 (March 1, 1956).

Using a sensitive detector system the spectral distribution of the recombination radiation from a specimen of InSb 1 thick is measured. The maximum lies at a wavelength betwee 7 and 8 microns. The results confirm that radiative recombination is the main recombination mechanism in InSb.

C.A.Hogart

537.311.3

4401. THE DETERMINATION OF THE EFFECTIVE MASS IN InSb AND InAs FROM MEASUREMENTS OF THE DIFFER ENTIAL THERMO-E.M.F. H.Weiss.
Z. Naturforsch., Vol. 11a, No. 2, 131-8 (1956). In German

Measurements of the electron effective mass m_n and t hole effective mass m_p gave the following values. For InAs in the range 300-800° K, $m_n = 0.064$ m and $m_p = 0.33$ m; for InSb at 333° K, $m_n = 0.037$ m and $m_p = 0.18$ m. C.A.Hogarth

537.311.3

4402. MEASUREMENT OF MINORITY CARRIER LIFETIM IN SILICON. R.L.Watters and G.W.Ludwig.
J. appl. Phys., Vol. 27, No. 5, 489-97 (May, 1956).

Discusses lifetime as measured by photoconductive decay and checked by a drift technique. The source of pulsed light, the presentation system, and other instrumentation is described. Limitations on the injection level and field are dis cussed, as well as the problems presented by trapping, barri and making contact to the crystal. Lifetime in excess of 1500 μsec in p-type crystals and 2500 μsec in n-type crystal has been observed at room temperature. The photoconductive decay constant (lifetime) is reported in n-type crystals from 78° to 450° K, and in p-type crystals from 160° to 450° K. Measurements on another p-type crystal permitted calculatic of the surface recombination velocity (~ 3500 cm/sec at 300° after grinding or etching with CP4) between 175° and 450° K.

A

537.311.33 : 539.2

4403. DIFFUSION OF DONOR AND ACCEPTOR ELEMEN IN SILICON. C.S.Fuller and J.A.Ditzenberger.
J. appl. Phys., Vol. 27, No. 5, 544-54 (May, 1956).

The diffusion of the Group III (B, Al, Ga, In and Tl) and Group V (P, As, Sb and Bi) elements in silicon has been meas ured in the temperature range 1050-1350° C. A method based change in conductivity through the penetration layer has beer used for B and P. The p-n junction method has been used for the other elements. Aside from B and P, which have similar diffusional properties, the acceptor elements diffuse more rapidly than the donor elements. Diffusion coefficients are given by $D_{B,P} = 10.5 \exp -(85\,000/RT)$, $D_{Al} = 8.0 \exp -(80\,000/RT)$, $D_{Ga} = 3.6 \exp -(81\,000/RT)$, $D_{In,Tl} = 16.5 \exp -(90\,000/RT)$, $D_{As} = 0.32 \exp -(82\,000$ R $D_{Sb} = 5.6 \exp -(91\,000/RT)$, $D_{Bi} = 1030 \exp -(107\,000$ RT) w an average estimated error of about ± 40%. This corresponds to

error in the activation energies of about ± 5 kcal. Sources of error including the effects of impurities in the oxides are discussed. D_0 values in most cases conform to the predictions of Zener for substitutional diffusion. A.

537.311.33

4404. PHOTON EMISSION FROM AVALANCHE BREAKDOWN IN SILICON. A.G.Chynoweth and K.G.McKay.
Phys. Rev., Vol. 102, No. 2, 369-76 (April 15, 1956).

Visible light is emitted from reverse-biased silicon p-n junctions at highly localized regions where avalanche breakdown is taking place. The emission occurs in both grown and diffused junctions. By using junctions diffused to a depth of only 2 microns below the crystal surface, it was established that the light sources are randomly spaced over the whole area of the junction as well as around the periphery where the junction intercepts the surface. The light sources are too small to be resolved under a high-power microscope. Their sites are reproducible with current cycling and their intensity and colour are relatively insensitive to the field distribution, to the junction width, and to temperature. The number of light spots increases with the current rather than individual spots growing brighter. It is concluded that all the breakdown current is carried through the junction by these localized light-emitting spots. The spectral distribution of the light is continuous with a long tail extending to photon energies greater than 3.3 eV. It is concluded that recombination between free electrons and free holes within the junction region is responsible for the light at the shorter wavelengths, the carrier energies in excess of the energy gap being supplied by the field. At longer wavelengths there appears to be a considerable contribution to the emission from intraband transitions. A tentative figure for the emission efficiency over the visible spectrum is one photon for every 10^8 electrons crossing the junction. The recombination cross-section required is reasonable, being about 10^{-22} cm^2. A.

537.311.33

4405. P-N JUNCTION THEORY BY THE METHOD OF δ FUNCTIONS. H.Reiss.
J. appl. Phys., Vol. 27, No. 5, 530-8 (May, 1956).

Describes a concise new method for calculating current-voltage phenomena in structures involving p-n junctions. In fact, the problem of the current-voltage characteristics of any one-dimensional p-n junction structure with any number of junctions and contacts is solved in a form general enough so that one only needs to insert the physical parameters of the structure into the formulae to write down its characteristics. A.

537.311.33

4406. ANALYSIS OF H_2S TREATED PbS POINT CONTACT RECTIFIERS. V.G.Bhide, J.N.Das and P.V.Khandekar.
Proc. Phys. Soc. B, Vol. 69, Pt 2, 245-8 (Feb., 1956).

Experiments on rectification made on specimens of n-type PbS of conductivity 400 ohm^{-1} cm^{-1} after varying degrees of treatment at 500°C with flowing H_2S, followed by quenching. The surface was converted to p-type by the treatment and the resulting rectification characteristics were in fair agreement with those expected on simple diode theory. C.A.Hogarth

537.311.33

4407. TEMPERATURE DEPENDENCE OF PHOTOCURRENTS IN p-n JUNCTIONS. R.Wiesner and E.Groschwitz.
Z. angew. Phys., Vol. 7, No. 10, 496-9 (Oct., 1955). In German.

The temperature dependence of photocurrent in a germanium photodiode is studied over the range 10-60°C. The dependence is determined by the diffusion length, i.e. the life time of the minority carriers. Effect of surface recombination is also investigated but is found to have little influence on the temperature dependence. G.F.J.Garlick

537.311.33

4408. THE SEMICONDUCTOR/SEMICONDUCTOR SYSTEM. K.Seiler and D.Geist.
Z. Elektrochem., Vol. 60, No. 1, 13-20 (1956). In German.

The preparation and electrical properties of germanium and silicon junction assemblies are described and discussed. C.A.Hogarth

537.311.33

4409. THE VAPOUR-PHASE/SEMICONDUCTOR AND METAL/SEMICONDUCTOR SYSTEMS. W.Schultz and H.U.Harten.
Z. Elektrochem., Vol. 60, No. 1, 20-8 (1956). In German.

Reviews the properties of semi-conductors which relate to the surface condition and in particular to the surface state density and energy. Measurements of contact potential, surface conductance, and rectification characteristics against a metal or electrolyte are described, and the effect of the ambient atmosphere on the surface properties is discussed. C.A.Hogarth

537.311.4

4410. CONTACT RESISTANCE AND CONTACT SURFACES. K.Millian and W.Rieder.
Z.angew. Phys., Vol. 8, No. 1, 28-34 (1956). In German.

An experimental investigation of the resistance of an electrical contact consisting of crossed cylinders. The dependence of the resistance on the contact metal (copper, silver, tungsten), on surface treatment, contact load and the growth of surface films is examined. M.R.Hopkins

537.312.5

4411. PHOTOCONDUCTIVITY IN MANGANESE-DOPED GERMANIUM. R.Newman, H.H.Woodbury and W.W.Tyler.
Phys. Rev., Vol. 102, No. 3, 613-17 (May 1, 1956).

Impurity photoconduction has been observed in n- and p-type Mn-doped germanium at low temperatures. The spectra are consistent with the published ionization energy values determined from conductivity data. High-resistivity n-type samples show high intrinsic photosensitivity and long response times at low temperatures. In such samples the intrinsic photocurrent could be quenched by a factor of ~10^4 with light in the 0.3 to 0.7 eV range. Intrinsic photoconductivity was found to vary more rapidly than linearly with light intensity over a limited range. A.

537.312.5 : 537.311.33

4412. PHOTOVOLTAIC EFFECT IN GaAs P-N JUNCTIONS AND SOLAR ENERGY CONVERSION. D.A.Jenny, J.J.Loferski and P.Rappaport.
Phys. Rev., Vol. 101, No. 3, 1208-9 (Feb. 1, 1956).

Measurements on six samples, not designed for optimum performance, gave a maximum solar energy conversion efficiency of 6.5%, which is less than anticipated. To fit the data to the theoretical expression for output current requires a thermally-induced reverse saturation current of 2.9 x 10^{-8} A, about 10^5 times that expected, with $q/kT = 17$ at 300°K. The short-circuit current was proportional to the number of (monochromatic) photons absorbed, with an energy cut-off at 1.35 eV, as predicted. T.H.D.Attewell

537.312.5 : 621.383

4413. NOISE IN SILICON P-N JUNCTION PHOTOCELLS. G.L.Pearson, H.C.Montgomery and W.L.Feldmann.
J. appl. Phys., Vol. 27, No. 1, 91-2 (Jan., 1956).

A silicon p-n junction photocell prepared by the gaseous diffusion process and biased in reverse showed no noise in excess of shot noise down to a frequency of 80 c/s in a dry atmosphere. In a humid atmosphere the excess noise was a factor of 3 x 10^8 above shot noise at 100 c/s and showed the familiar 1/f spectrum. A.

537.312.62

4414. A STATISTICAL THEORY OF SUPERCONDUCTIVITY. K.H.Schramm.

Ann. Phys. (Leipzig), Vol. 17, No. 2-3, 155-69 (1956). In German.

Develops the statistical mechanics of a system of "three-dimensional oscillators" of energy $E = h\nu\,(n_1 + n_2 + n_3 + 3/2)$, obeying Fermi statistics, and applies it to Kronig's (1932) "electron crystal" model of a superconductor. R.G.Chambers

537.312.62 : 534.23

4415. ULTRASONIC ATTENUATION IN SUPERCONDUCTING INDIUM. R.W.Morse, P.Tamarkin and H.Bohm.
Phys. Rev., Vol. 101, No. 5, 1610-11 (March 1, 1956).

Measurements were made by a 10 Mc/s pulse method between 4.2° K and 1.5° K, on two specimens of different purity. The attenuation was about five times greater in the purer specimen; in both specimens it fell by about 40% on cooling through the transition temperature, and thereafter fell as T^3. R.G.Chambers

537.32 : 536.7

4416. THE KELVIN RELATIONS IN THERMO-ELECTRICITY. E.H.Sondheimer.
Proc. Roy. Soc. A, Vol. 234, 391-8 (Feb. 21, 1956).

A general proof is given of the Kelvin relations among the thermoelectric effects in conducting crystals, the departure from equilibrium of both the electron and the lattice distribution functions being taken into account. It is emphasized that the theory of the transport phenomena in conductors must be formulated so as to treat the mutual interaction between electrons and lattice vibrations in a fully symmetrical way. A.

537.323

4417. THERMOELECTRIC POWER OF AuCu IN NON-EQUILIBRIUM STATES. H.Cooper, P.Schwed and R.W.Webeler.
J. appl. Phys., Vol. 27, No. 5, 516-19 (May, 1956).

Measurements have been made of the resistivity ρ and of the thermoelectric power Q (v. Pt) of samples of AuCu in various nonequilibrium states. One set of samples was disordered by quenching from 750° C; and annealing curves were obtained at 100°, 149°, 198° and 258° C. A second set was first ordered and then cold worked to essentially complete disorder, and annealing curves taken at 149° C and 258° C. Of the former set, the $Q-\rho$ curves for 100° and 149° C showed a maximum at $\rho \cong 11.5$ μohm cm while none was observed in the curves for any of the other cases. It follows from the detailed results that to specify the state of the alloy it is necessary to give, in addition to ρ and Q, at least one other quantity such as the coefficient of magnetoresistivity. A.

ELECTRIC DISCHARGES 537.52

537.521 : 536.75

4418. RELATION OF STEENBECK'S MINIMUM PRINCIPLE TO THE THERMODYNAMIC PRINCIPLE OF MINIMUM ENTROPY PRODUCTION. T.Peters.
Z. Phys., Vol. 144, No. 5, 612-31 (1956). In German.

It is shown that the principle of minimum running voltage for a discharge tube (Steenbeck's principle) can be related to the principle of minimum entropy production well-known in the thermodynamic treatment of irreversible processes. In a channel model of an electric arc column, it is shown that the requirement of fulfilment of the first and second laws of thermodynamics leads directly to the Steenbeck's principle $dE/dr = 0$ or $dE/dT = 0$. In the discussion of the results reference is made to the approximate character of the phenomenological theory of irreversible processes, as revealed by the deduction of Euler's equations. Successful application of the minimum principle to the cathode fall of potential region and to detonation waves shows that the 2nd law still applies in regions in which the phenomenological theory is bound to fail. Attention is also drawn to the similarity between conditions in the region of cathode potential drop and in the front of a detonation wave. R.C.Murra

537.523.

4419. CURRENT DISTRIBUTION IN AN EXPANDING SPARK CHANNEL. J.M.Somerville and C.T.Grainger.
Brit. J. appl. Phys., Vol. 7, No. 3, 109-10 (March, 1956).

Describes observations on the appearance of the anode spots, on specially prepared electrodes, in spark discharges (attention is directed to the channel or transient arc phase). There is evidence of initial peripheral flow of current in the discharge and reference is made to other work on the shock regime existing at the beginning of a spark discharge. J.D.Cragg

537.523.5

4420. RADIATION FROM GASEOUS ARCS. K.S.W.Champi
Proc. Phys. Soc. B, Vol. 69, Pt 1, 120-1 (Jan., 1956).

An extension of previous work (Abstr. 3340/1953). Formu for the radiation from arcs in which (a) thermal excitation and (b) electron and ion collisions cause radiation are quoted and briefly discussed. J.D.Craggs

537.523.

4421. ARCS OF HIGH LIGHT INTENSITY WITH THORIUM OXIDE ANODES. N.Riehl.
Z. angew. Phys., Vol. 7, No. 12, 582-4 (Dec., 1955). In German.

Briefly describes some properties of arcs in air with oxidized thorium anodes. The brightness of the anode spot may be as high as 90 000 stilb. For an arc length of 5-8 mm and 8 A current the arc voltage drop was 25-30 V. J.D.Cragg

537.52

4422. TWO-ELECTRODE H.F. DISCHARGE AT PRESSURE FROM 100 mm Hg TO ATMOSPHERIC PRESSURE.
G.S.Solntsev and M.M.Dmitrieva.
Zh. éksper. teor. Fiz., Vol. 29, No. 5(11), 651-7 (1955). In Russian.

Field strength in the discharge channel rises from 75 to 220 V_{eff}/cm (air) and 90-200 V_{eff}/cm (nitrogen), corresponding to conditions of high-pressure surface discharges. In argo the discharge channel is contracted at 300 mm Hg, with corresponding increase of current density and reduction of field strength, both contracted and noncontracted discharges being possible in the 300-500 mm range. Field strengths rang from 25 to 60 V_{eff}/cm (100-500 mm Hg), 20-30 V_{eff}/cm for contracted discharge (400-760 mm). Electrical Research Association

537.525 : 536.7

4423. UNIFIED DYNAMICS AND THERMODYNAMICS OF THERMAL PLASMA. H.Maecker and T.Peters.
Z. Phys., Vol. 144, No. 5, 586-611 (1956). In German.

A unified theory of the dynamics and thermodynamics of a thermal plasma is derived, which yields equations for mass energy and electrical flow for a pure plasma with only two oppositely-charged components and for one with one neutral gas component, of which the electrical and the ambipolar flow equations agree with those derived by Schluter from plasma dynamics constructed solely on hydrodynamic principles. The third, energy-flow equations relates energy flow to motion of the c.g. of the system, to electrical and ambipolar flow and finally to heat conduction by direct contact without flow. Although the system of equations can only be solved in a few simple cases, it does reveal the physical processes which ca occur in a thermal plasma. R.C.Murra

537.525.

4424. ENERGETICS OF ELIMINATION OF ADSORBED GASES FROM DIELECTRIC SURFACES UNDER ELECTROD

LESS DISCHARGE. S.R.Mohanty.
Nuovo Cimento (Ser. 10), Vol. 3, No. 1, 219-20 (Jan., 1956).
Time variations of the Joshi effect (i.e. the influence of visible light on certain high voltage low pressure a.c. corona discharges) are studied and briefly discussed. J.D.Craggs

537.527.5

4425. THE "TOTAL EXCITATION" AND EFFECTIVE IONIZATION POTENTIAL OF AN ATOM IN THE INTERIOR OF THE PLASMA. G.Ecker and W.Weizel.
Ann. Phys. (Leipzig, Vol. 17, No. 2-3, 126-40 (1956). In German.
Discusses, with full references to the literature, the "lowering" of the ionization potentials of atoms in plasmas when the degree of ionization is appreciable. A theoretical treatment is worked out and the results, plotted against electron densities are given. Attention is directed particularly to high-pressure, high-current, mercury vapour arcs. J.D.Craggs

537.527.5

4426. SPECTROPHOTOMETRIC MEASUREMENTS ON A WALL-STABILIZED XENON HIGH-PRESSURE DISCHARGE. W.Neumann.
Ann. Phys. (Leipzig), Vol. 17, No. 2-3, 146-54 (1956). In German.
Detailed experiments were carried out on a XF3000 high-pressure xenon arc and quantitative values obtained for the intensity variations in the emission spectrum (lines and background continuum) over the wavelength range 4000-10 000 A. Absolute measurements of the continuum intensity were made. The plasma temperature so determined was $7450 \pm 400^{\circ}$K. The excitation potential for the continuum was found to be 11.8 ± 0.3 V. J.D.Craggs

X-RAYS 537.531

537.531

4427. X-RAY EQUIPMENT FOR THE ATOMIC PHYSICS LABORATORY. W.A.Hilton and G.T.Clayton.
Amer. J. Phys., Vol. 24, No. 5, 362-3 (May, 1956).
Equipment using obsolete medical X-ray machines to perform the basic X-ray absorption and diffraction experiments for the undergraduate atomic physics laboratory is described. A.

537.531 : 535.34

4428. X-RAY ABSORPTION EDGES OF TRANSITION METAL SALTS. H.P.Hanson and J.R.Knight.
Phys. Rev., Vol. 102, No. 3, 632-5 (May 1, 1956).
A series of K-edges of transition elements in ionic compounds are presented. It is found that absorption in the 3d region is most prominent in cases where the bonding is least ionic and the symmetry is lowest. As the 3d levels become progressively filled, this low-lying absorption disappears. A.

537.531 : 535.343

4429. ON THE X-RAY ABSORPTION FINE STRUCTURE WITH POLARISED X-RAYS. A.N.Nigam.
Physica, Vol. 21, No. 12, 924 (Dec., 1955).
Suggests an explanation of the small variation with direction of polarization in the fine structure of the Cl K-absorption edge of NaCl (see Abstr. 3534/1954). A.R.Stokes

537.531 : 537.591.8

4430. MESONIC X-RAYS FROM CAPTURE OF COSMIC-RAY μ MESONS IN A CHEMICAL COMPOUND. A.Fafarman and M.H.Shamos.
Phys. Rev., Vol. 100, No. 3, 874-9 (Nov. 1, 1955).
Measurements have been made of the X-rays emitted by mesonic carbon and oxygen atoms formed by the capture of negative cosmic-ray μ-mesons. A 4 litre tank of liquid scintillator, dioxane, $C_4O_2H_8$ (plus 10 g/l. of p-terphenyl) served as the absorber and as the detector for the stopping of cosmic-ray μ-mesons. The mesons were identified by the method of delayed coincidences. The mesonic X-rays from the dioxane were detected by a scintillation spectrometer. Spectrometer pulses in coincidence with the stopping meson were lengthened and their pulse height recorded on a recording milliammeter. The time distribution of the delayed coincidences was recorded over the delay interval 0.5 to 8.0 μsec. The measured 2p-1s transition energies of 82 keV and 145 keV, for carbon and oxygen respectively, agree with the simple Bohr orbit calculations within the precision of the measurement. The observed ratio of captures by oxygen and carbon (0.33 ± 0.04) does not agree with the Z-dependence predicted by Fermi and Teller for mesonic atom formation by chemical compounds (0.67) nor with the simple stopping power calculation (0.50); however, in view of the thick absorber (14 cm depth of dioxane), the above experimental ratio is uncertain because of Compton degradation of the oxygen 2p-1s radiation which shifts some events from the oxygen to the carbon peak. The observed distribution of delays is consistent with the assignment of the observed radiation to μ-meson capture. A.

537.531 : 539.18

PROPORTIONAL COUNTER MEASUREMENTS OF π-MESONIC X-RAYS FROM BERYLLIUM. See Abstr. 4017

537.531 : 778.33

4431. HIGH-RESOLUTION MICRORADIOGRAPHY. W.A.Ladd, W.M.Hess and M.W.Ladd.
Science, Vol. 123, 370-1 (March 2, 1956).
Surfaces of $(NH_4)_2Cr_2O_7$ crystals and of polyvinyl films are found to be grainless and sensitive to X-rays, the effect being to produce changes in the solubility of the irradiated surface. 10 kV X-rays passing through the material under investigation fall on one of these sensitive surfaces which are afterwards developed in relief by dissolving away the more soluble parts. A thin replica of this relief is then shadow-cast and made suitable for examination under an electron microscope. Useful magnifications of up to 25,000 diameters can be obtained without subjecting biological materials to destruction within the electron microscope. D.V.Mabbs

537.531.08

4432. INFLUENCE OF THE POLARIZATION CORRECTION (FERMI CORRECTION) FOR ELECTRON STOPPING POWER ON DOSAGE MEASUREMENT WITH VERY HARD X-RAYS. G.Breitling and R.Glocker.
Naturwissenschaften, Vol. 42, No. 17, 483 (1955). In German.
Comparative measurements of radiation energy by means of (1) ionization and (2) the light intensity produced in a phosphor of low atomic number, are made for 400 kV X-rays, where the Bragg—Gray constants are known, and for 31 MeV X-rays, where the polarization correction is significant. The comparison yields a polarization correction factor of 3% for these conditions. For a monoenergetic electron beam having the same energy as that of the most energetic Compton electrons from 31 MeV X-rays, the correction is 10%. Reasons for this are discussed. D.V.Mabbs

CATHODE RAYS. POSITIVE RAYS 537.533/534

537.533

4433. THE NON LINEAR THEORY OF BETATRON OSCILLATIONS IN THE STRONG-FOCUSING SYNCHROTRON. I. Y.Orlov.
Nuovo Cimento (Ser. 10), Vol. 3, No. 2, 252-9 (Feb., 1956).
A new method for the investigation of betatron resonances has been developed. The resonances due to errors in the field gradient have been examined. A.

537.533 : 621.384.612

4434. THE GLASGOW 340-MeV SYNCHROTRON.
W.McFarlane, S.E.Barden and D.L.Oldroyd.
Nature (London), Vol. 176, 666-9 (Oct.8,1955).

The electron-synchrotron was first operated at 340 MeV in April 1954. The magnet is made up of 20 C-shaped units giving an annular gap of 125 cm mean radius, 18 cm width and 10 cm mean height. The oscillatory discharge of an 860 μF condenser bank, at 17 kV, through triggered ignitrons provides current for the betatron flux and guide field, the peak current of 3750 A giving 9000 gauss. The rate of increase of flux is 0.8 gauss/μsec during the betratron phase increasing to 2 gauss/μsec with the saturation of flux bars clamped to the inner faces of the C-units. Two quarter-wave coaxial resonators produce the synchronous electron acceleration with a frequency 38.2 ± 1.6 Mc/s and a peak-gap potential of 1700 V. The energy gained per revolution in the betatron phase rises from about 850 eV to 1700 eV when the flux bars saturate, transition to the synchrotron phase occurring at about 4 MeV. The toroidal vacuum chamber is made up of moulded ceramic sectors internally coated with Pt. A diode electron gun injects up to 1 A of electrons in a 5 μsec, 70 kV pulse which must be accurately timed to 0.1 μsec. The gamma-ray beam is obtained by switching off the r.f. supply near the peak field and allowing the electrons to spiral inwards to a tungsten target. A steady output of 2000 r/min can be obtained. L.R.Shepherd (R)

537.533 : 621.384.612

4435. ON THE INFLUENCE OF MAGNETIC FIELD ERRORS ON THE BETATRON OSCILLATIONS IN STRONG FOCUSING SYNCHROTRONS. G.Lüders.
Nuovo Cimento Suppl. (Ser. 10), Vol. 2, No. 4, 1075-146 (1955). In German.

This paper summarizes researches done under the auspices of CERN in a systematic and mathematically complete form. Errors of the guiding field and the field index as well as their combination are investigated, but errors leading to coupling of horizontal and vertical oscillations are not treated. Statistical assumptions are made regarding errors resulting from the limitations of accuracy of construction methods for such a machine. Curves showing the effect of stochastic construction errors on the equilibrium orbit and the width of the unstable regions are given. Appendices contain a new derivation of the equations of motion and a perturbation treatment of small changes of the field index. H.Motz

537.533.2

4436. FIELD EMISSION FROM METALS INTO ALKALI HALIDE CRYSTALS. M.Geller.
Phys. Rev., Vol. 101, No. 6, 1685-93 (March 15, 1956).

The transient photocurrents associated with the movement of photoelectrons in additively coloured alkali halide crystals, and the accompanying growth of positive space charge at the cathode leading to field emission, has been previously calculated and verified by room temperature measurements. These experiments have been extended to low temperatures and the theory has been expanded to include the final photocurrents produced by the space-charge enhanced field. From measurements of the initial current, its time constant and of the final current, a field strength at the cathode can be derived and correlated to the final current density. Fowler–Nordheim plots yield a straight line, as expected for field emission, but the order of magnitude of the calculated field and the "apparent" work function are too small to be reasonable. The work function exhibits a dependence on light intensity. The field emission should be nearly independent of temperature, and this is verified. The photocurrent decreases from room temperature to −130°C by a factor of only two; this decrease can be attributed to the lowered mobility of the electrons in the crystal. Final photocurrent v. voltage curves for various metals and composite surfaces indicate that the photocurrent is controlled by the ionized F centres in a thin surface layer of the crystal and that the image forces of these centres create the high fields required for emission. A.

537.533

4437. THEORETICAL INTERPRETATION OF FIELD EMISSION EXPERIMENTS. T.J.Lewis.
Phys. Rev., Vol. 101, No. 6, 1694-8 (March 15, 1956).

In careful experiments by Dyke and his co-workers it has been observed that the field-emission currents from tungsten and barium-on-tungsten emitters were progressively reduced below that expected from the Fowler–Nordheim law as the field was increased. These effects were attributed to electron space charges in the neighbourhood of the emitters. However, if a detailed examination of the surface-energy barrier is made, it is found that the barrier existing in the experiments was almost certainly different from that assumed in the derivation of the Fowler–Nordheim law. This is particularly true for the coated emitters because of the formation of barium double-layer patches, but even for clean tungsten emitters failure of the image-force "motive" within ~3 A from the surface, as discussed by Slater and others, must occur. If these effects are taken into account, new estimates of the emission current show good agreement with experiment, the observed deviations from the Fowler–Nordheim law being predicted with accuracy. It is concluded therefore that space charges are not necessarily responsible for the deviations found and that in any case the form of the energy barrier should be taken into account. It is suggested that the experiments may offer in fact significant information concerning the fields in the neighbourhood of the emitter. A

537.533.2

4438. ON ELECTRON EMISSION FROM COLD METALLIC SURFACES UNDER MODERATE FIELD STRENGTHS (~ 10^4 V/cm). K.Kerner.
Z. angew. Phys., Vol. 8, No. 1, 1-8 (1956). In German.

Cold electron emission from unoutgassed parallel plane metal surfaces at pressures ~ 10^{-5} mm Hg was investigated. Iron, silver and aluminium surfaces were used in different states of surface finish. The experimental results are compared with those of other workers and it is concluded that they are best described in terms of the Schottky equation. C.G.Morgan

537.533.2 : 537.312.6

4439. INVESTIGATION OF ELECTRON EMISSION FROM SUPERCONDUCTORS. F.Bedard, H.Meissner and G.E.Owen
Phys. Rev., Vol. 102, No. 3, 667-70 (May 1, 1956).

Electron emission from a superconducting tin surface at low electric field strengths was sought for. The sample was the cathode of an electron gun, which was focused on a NaI(Tl) crystal. A photomultiplier tube and associated pulse counting equipment was used as a detector for light pulses. The measurements indicate that at a field strength of 570 V/cm the order of magnitude of such emission is less than 100 electron cm^2-sec, under the surface conditions used. A

537.533.2 : 621.385.032.213.

4440. HIGH FIELD ELECTRON EMISSION FROM IRREGULAR CATHODE SURFACES. T.J.Lewis.
J. appl. Phys., Vol. 26, No. 12, 1405-10 (Dec., 1955).

Electron emission from a cathode surface produced by an applied field E is enhanced by the presence of projections on the emitter surface which cause a local increase in E. The nature of this enhancement factor $\mu(z)$, which is a function of the distance z from the cathode, is discussed more fully than hitherto and its magnitude is calculated for certain ideal but realistic geometries. Although such a factor may be large on the surface (z = 0), it decreases rapidly as z increases so that the mean field magnification $\bar{\mu}(z)$, which is required in the Schottky thermionic emission theory, is unlikely to be > 2 and is probably near to unity even for fields of 5 x 10^5 V/cm. This means that the Fowler-Nordheim theory frequently used to explain emission results at these fields is not applicable and that a Schottky theory should be used. It is also shown that $\bar{\mu}(z)$ is itself field-dependent and produces departures from the

Schottky law in such a way that the slope of current v.$E^{\frac{1}{2}}$ plot increases rapidly for $E < 10^3$ V/cm, remains approximately constant for $10^3 < E < 10^4$ V/cm, and then increases again at higher fields. A similar reasoning shows that deviations from the Fowler-Nordheim law for fields $> 10^6$ V/cm can also be expected. Finally, the assumption of a constant emitting area for rough cathodes is also shown to give departures from the emission laws such that the estimated current density at high fields is appreciably less than the expected values. These deductions help to explain some of the anomalous results frequently found in many conduction experiments in gases and liquids. A.

537.533.35

4441. INTERMEDIATE LABORATORY EXPERIMENT IN PHYSICAL OPTICS USING AN ELECTRON MICROSCOPE. J.L.Rood.
Amer. J. Phys., Vol. 24, No. 5, 388-9 (May, 1956).

An undergraduate laboratory experiment to study the magnification and limit of resolution of an electron microscope, appropriate to a physical optics course, is described. Polystyrene latex spheres of known diameter are used to obtain the magnification. The experiment introduces the student to some of the techniques of electron microscopy. A.

537.533.35

4442. PRINCIPLE OF A HIGH-RESOLUTION MAGNETIC DOUBLE-FIELD β-SPECTROMETER. H.J.Leisi.
Helv. phys. Acta, Vol. 28, No. 5-6, 460-3 (1955). In German.

Considers a spectrometer consisting of two adjacent sectorial uniform field regions. By a suitable choice of their angular extent and relative field strengths, the aperture error can be reduced to a value considerably lower than that obtaining in the usual single-region spectrometer. E.A.Ash

537.533.35

4443. MAGNETIC SPECTROGRAPH WITH PRE-ACCELERATION FOR THE STUDY OF LOW-ENERGY ELECTRONS. S.Rosenblum, J.Sant'ana Dionisio and M.Valadares.
J. Phys. Radium, Vol. 17, No. 2, 112-16 (Feb., 1956). In French.

Line spectra of low energy (0-100 keV) conversion electrons were detected on photographic plates in a 180° instrument described here. By employing acceleration near the source, exposure time was considerably reduced. The instrument was tested using long- and short-lived active sources whose spectra are well known; results were in excellent agreement with previous data and, in addition, many new weak lines were observed. Several improvements are envisaged and further applications are suggested. N.M.King

537.533.74

4444. THE ELASTIC SCATTERING OF HIGH ENERGY ELECTRONS BY BERYLLIUM. M.K.Advani, G.Z.Shah and K.M.Gatha.
Curr. Sci., Vol. 24, No. 11, 367-8 (Nov., 1955).

Experimental data on nuclear scattering of 125 MeV and 190 MeV electrons by beryllium, (Abstr. 1389, 8340/1954), is analysed on the basis of a nuclear density distribution given by Gatha and Shah. Theoretical and experimental form factors show reasonable agreement after suitable normalization of the latter. N.M.King

537.533.74

4445. ELASTIC SCATTERING OF 188-MeV ELECTRONS FROM THE PROTON AND THE ALPHA PARTICLE. R.W.McAllister and R.Hofstadter.
Phys. Rev., Vol. 102, No. 3, 851-6 (May 1, 1956).

The elastic scattering from gaseous targets of hydrogen and helium has been studied. Elastic profiles have been obtained at laboratory angles between 35° and 138°. The areas under such curves, within energy limits of ± 1.5 MeV of the peak, have been measured and the results plotted against angle. In the case of hydrogen, a comparison has been made with the theoretical predictions of the Mott formula for elastic scattering and also with a modified Mott formula (due to Rosenbluth) taking into account both the anomalous magnetic moment of the proton and a finite size effect. The comparison shows that a finite size of the proton will acount for the results and the present experiment fixes in this size. The root-mean-square radii of charge and magnetic moment are each $(0.74 \pm 0.24) \times 10^{-13}$ cm. In obtaining these results it is assumed that the usual laws of electromagnetic interaction and the Coulomb law are valid at distances less than 10^{-13} cm and that the charge and moment radii are equal. In helium, large effects of the finite size of the alpha-particle are observed and the r.m.s. radius of the alpha-particle is found to be $(1.6 \pm 0.1) \times 10^{-13}$ cm. A.

537.533.74 : 539.172

4446. POTENTIAL SCATTERING OF HIGH-ENERGY ELECTRONS IN SECOND BORN APPROXIMATION. R.R.Lewis, Jr.
Phys. Rev., Vol. 102, No. 2, 537-43 (April 15, 1956).

Formulae are derived for the scattering cross-section of a high-energy electron in a static potential, correct to second order in the potential, in terms of certain integrals. The potential is that due to a screened, spherical charge distribution. The integrals are evaluated explicitly for Yukawa, exponential and Gaussian charge distributions, and are expanded in power series in k and in 1/k for an arbitrary charge distribution. Numerical results are presented. A.

537.533.75

4447. ON THE RANGE—ENERGY CURVE OF SLOW ELECTRONS IN NUCLEAR EMULSIONS. J.P.Lonchamp and C.Gégauff.
J. Phys. Radium, Vol. 17, No. 2, 132-3 (Feb., 1956). In French.

The problem of range—energy relations for slow electrons has been treated semi-theoretically by calculating first the electron range in the gelatine and then, by determining the average number of traversed— and reduced— grains. Values have been tabulated for energies between 1 and 10 keV.
E.W.Kellermann

537.533.8

4448. AUGER ELECTRON EMISSION IN THE ENERGY SPECTRA OF SECONDARY ELECTRONS FROM Mo AND W. G.A.Harrower.
Phys. Rev., Vol. 102, No. 2, 340-7 (April 15, 1956).

With the aim of determining to what extent the energy distribution of secondary electrons from targets of Mo and W may contain fine structure, measurements have been made using primary energies from 100 to 2000 electron volts. An electrostatic analyser of the 127 degree type having an experimentally determined resolution of one percent was used. Observations of the pressure in the vacuum system, after heating the target above 2000° K and cooling to room temperature, showed that an energy spectrum could be recorded before formation of the first monolayer of contamination on the target surface. Energy distribution measurements revealed: (1) Several subsidiary maxima at fixed differences in energy from the primary energy, these differences being characteristic of the target material and independent of the primary energy itself. (2) Several subsidiary maxima in the energy distribution at fixed positions along the energy scale lying between 10 and 500 electron volts, characteristic of the target material, and independent of the primary voltage. The maxima described in (1) are considered to be primary electrons reflected after suffering discrete losses of energy to the target. These discrete losses are believed to indicate the positions of the higher energy levels of the target material. The maxima described in (2) are interrupted as Auger electrons. Combining the energy level values determined from the discrete loss measurements with energy values for the deeper-lying levels available from X-ray studies, it is possible to predict the energies with which Auger electrons might be expected to be emitted. Some of the

predicted energies for Auger electrons agree reasonably well with the energies observed experimentally both for Mo and for W. A.

537.533.8

4449. ENERGY DISTRIBUTION IN THE SPECTRUM OF X-RAY BREMSSTRAHLUNG OF THIN ANODES IN DEPENDENCE ON ATOMIC NUMBER. II. H.Amrehn.
Z. Phys., Vol. 144, No. 5, 529-37 (1956). In German.

For previous part see Abstr. 6216 (1955). Measurements are carried out with voltages of 25 and 34 kV employing a proportional counter. Results agree reasonably well with the Sommerfeld theory and the Sommerfeld–Wiedmann modified theory. G.E.Brown

537.533.8 : 537.226

4450. THE SECONDARY ELECTRON EMISSION OF DIELECTRICS. A.R.Shulman.
Zh. tekh. Fiz., Vol. 25, No. 12, 2150-6 (1955). In Russian.

Secondary electron emission of non-metals can only be investigated by methods not destroying the target of the electron bombardment. Differences in the secondary emission coefficient σ of non-metallic emitters are only due to different emitter characteristics, not to accessory effects. $\sigma = f(V_p)$ for amorphous dielectrics, dielectrics with destroyed lattice or a large number of imperfections, has the usual form with a maximum, whereas for some crystalline dielectrics with perfect lattice it has a different character.
Electrical Research Association

537.533.9

4451. ON ČERENKOV RADIATION. N.L.Balazs.
Amer. J. Phys., Vol. 24, No. 4, 185-8 (April, 1956).

The radiation is treated using a generalization of Dirac's representation of the four potentials. In this way the case of moving media can be also discussed. A.

537.533.9 : 538.566

INCIDENCE OF AN ELECTROMAGNETIC WAVE ON A "ČERENKOV ELECTRON GAS". See Abstr. 3867

537.534.3

4452. RESOLUTION OF THE ATOMIC STRUCTURE OF A METAL SURFACE BY THE FIELD ION MICROSCOPE. E.W.Müller.
J. appl. Phys., Vol. 27, No. 5, 474-7 (May, 1956).

A formula for the resolution of the field ion microscope is derived by considering that most of the ions originate from rebounding molecules after random elastic collision with the surface. Cooling the tip with solid N_2, or liquid H_2 in order to obtain a large accommodation coefficient drastically reduces the lateral velocity of the ions in a helium operated microscope. As a result the potential resolution for a tip of radius 1000 A is improved to 1.5 A. Photographs show the individual atoms of a tungsten surface. The actual resolution is sufficient to resolve neighbouring atoms with 2.74 A separation. A.

537.534.74

4453. t-t ELASTIC SCATTERING FROM 1.6 to 2.0 MeV. D.M.Holm and H.V.Argo.
Phys. Rev., Vol. 101, No. 6, 1772-9 (March 15, 1956).

A magnetically analysed triton beam from an electrostatic accelerator has been scattered from tritium in a 14 inch scattering chamber and the differential cross-section for elastic scattering measured in 10° steps from 20° to 140° in the centre-of-mass system for incident energies of 1.8 and 2.0 MeV. Two proportional counters with a fixed angular separation of 90° were used in coincidence to detect both the scattered and recoil tritons for the laboratory range from 45° to 70°, with an absolute probable error of $\pm$ 3%. A single counter was used for laboratory angles between 10° and 20°, with resultant probable errors of +5%, −15%. Excitation functions in 100 keV steps from 1.6 to 2.0 MeV show no evidence for an excited state of He^6 in this region. A.

537.534.74

4454. DIFFERENTIAL CROSS SECTION FOR PROTON–HELIUM SCATTERING NEAR 17.5 MeV. K.W.Brockman, Jr.
Phys. Rev., Vol. 102, No. 2, 391-6 (April 15, 1956).

The differential cross-section for the elastic scattering o 17.45 $\pm$ 0.2 MeV protons by helium has been measured at 33 angles between the centre-of-mass angles 6.4 to 168 degrees. An external beam of protons from the Princeton cyclotron was scattered by helium gas in the interior of the Princeton 60 inc precision scattering chamber, scattered particles being detected in a potassium iodide scintillation counter. Values found for the cross-section are considered to have an overall accuracy of 2% except at the smallest angles where the error was larger due to experimental difficulties. The resulting data hav been analysed in terms of phase shifts of the S, P, D and F waves with the following results: $S_{1/2}$, -100.7°; $P_{3/4}$, 81.2°; $P_{1/2}$, 36.4°; $D_{5/2}$, 157.8°; $D_{3/2}$, 10.9°; and F, 1.2°. These values provide a least-squares fit to the experimental curve. A.

537.534.74

4455. ELASTIC SCATTERING OF 340-MeV PROTONS BY DEUTERONS. O.Chamberlain and D.D.Clark.
Phys. Rev., Vol. 102, No. 2, 473-85 (April 15, 1956).

The differention cross-section for the elastic scattering of 340 MeV protons by deuterons has been measured at eight angles from 30° to 150° in the centre-of-mass system. A coin cidence counting system using scintillation counters detected both product particles, the elastic effect being separated from the inelastic through identification of the scattered deuterons by photographically recorded pulse heights produced in a coun ter telescope. The resulting cross-section is, at 30°, 2.2 mb/ steradian; 40°, 0.89; 50°, 0.39; 70°, 0.11; 90°, 0.047; 110°, 0.042; 130°, 0.047; and 150°, 0.099, in centre-of-mass units. The total (statistical and systematic) errors range from 15 to 24%. The total elastic cross-section is estimated to be 6.0 $\pm$ 1.2 mb. Problems of interpretation using the impulse approximation are discussed; the sticking factor is calculated for three different n-p potentials. At scattering angles of 30° and 40° there appears to be very little interference effect between n-p and p-p scattering. The interference is perhaps slightly destructive. A

537.534.74 : 539.172.11

4456. INELASTIC SCATTERING OF 42-MeV α'S BY Mg. P.C.Gugelot and M.Rickey.
Phys. Rev., Vol. 101, No. 5, 1613-14 (March 1, 1956).

Graphs are given for the differential cross-section for this process and more specifically for inelastic scattering leading to the excitation of the 1.37 MeV level in Mg^{24}. An explanation for the distribution on the basis of a weak direct interaction between the core of the nucleus and the alpha particle represents the data reasonably well. J.Hughes

537.534.74 : 539.172.13

4457. INELASTIC SCATTERING OF 18 MeV PROTONS BY Mg^{24}. P.C.Gugelot and P.R.Phillips.
Phys. Rev., Vol. 101, No. 5, 1614-15 (March 1, 1956).

The differential cross-section for the excitation of the 1.37 MeV level in Mg^{24} is presented graphically, and a comparison with other results at lower proton energies made. The angular dependence of the cross-section is such that the surface interaction theory used to explain the inelastic scattering of alpha particles (preceding abstract) is not valid, and it may be necessary to take into account the internal structure of the nucleus. J.Hughes

DISCHARGE TUBES. COUNTERS 537.54

537.542

4458. A SIMPLE METHOD FOR THE DETERMINATION OF GEIGER COUNTER DEAD TIMES. L.Danguy.
Physica, Vol. 21, No. 12, 988-9 (Dec., 1955). In French.

Describes a double count method for the experimental determination of dead time, using for one count an artificial quenching time and for another the natural dead time. An example is given. J.D.Craggs

537.542

4459. ON THE USE OF COUNTER TUBES WITH TIN TETRAMETHYL FILLINGS. W.Bambynek and V.Freise.
Z. Naturforsch., Vol. 11a, No. 2, 168-9 (1956). In German.

Enumerates the advantages of the above gas filling for G.M. counters and gives characteristics of tubes filled with it (5-20 mm Hg pressure). The application to C^{14} work is briefly described. J.D.Craggs

537.542 : 539.164

4460. THE DESIGN OF A MULTIPLE WIRE PROPORTIONAL COUNTER AND ITS USE IN THE STUDY OF THE α-PARTICLES FROM THE REACTION $^7Li + p$. A.C.Riviere and P.B.Treacy.
Austral. J. Phys., Vol. 8, No. 3, 408-11 (Sept., 1955).

A description and schematic view of the counter are given. A graph of the α-particle spectrum from the above reaction is given, and it can be deduced from it that if Be^8 levels between 7 and 15 MeV are excited, their intensity must be $< 3\%$ of that of the ground-state transition. J.Hughes

537.542

4461. GENERAL ASPECTS OF THE USE OF IMPULSE FISSION CHAMBERS. P.Hubert.
Onde élect., Vol. 35, 974-6 (Nov., 1955). In French.

Construction and properties are described of pulse ionization chambers containing layers of fissile material. Irradiation of the chambers with neutrons causes ionization by fission products within the chamber gas (e.g. A + 5% CO_2). U^{235} layers are used for detecting thermal neutrons, Th^{232}, U^{238} or Np^{237} for fast neutrons. It is necessary to discriminate against the strong natural α-particle emission from these materials: a typical curve is shown and explained.
D.V.Mabbs

537.542 : 539.163.1

4462. MEASUREMENT OF THE HALF-LIFE OF RADON WITH A CURIE-TYPE IONIZATION CHAMBER. P.C.Marin.
Brit. J. appl. Phys., Vol. 7, No. 5, 188-90 (May, 1956).

An improved version of the Curie-type ionization chamber is described which enables an accurate comparison to be made of the ionization currents produced by γ-rays. The ionization current produced by 1 mc of radium can be measured with an accuracy of 0.02%. The linearity of response of this instrument has been investigated for radon sources up to 250 mc, with an argon gas filling. The half-life of radon measured in this way was found to be $3.8229 \pm 0.000\,27$ days. A.

537.542

4463. VARIATIONS IN THE PHOTOCONDUCTIVITY AND IN THE ELECTRICAL COUNTING PROPERTIES OF DIAMONDS. F.C.Champion and B.Dale.
Proc. Roy. Soc. A, Vol. 234, 419-32 (Feb. 21, 1956).

The electrical conductivity produced by β-ray bombardment and by light irradiation in several diamonds was investigated in the temperature range 150 to 500°K. Considerable uniformity was observed in the behaviour of the specimens; all of them polarized strongly in the dark at room temperature, and polarization could be effectively eliminated by pulsing the electric field while maintaining the β-flux. Both the counting response and the photoconductivity increased as the temperature was lowered. This was interpreted as being largely due to an increase in the mobility of the charge carriers at lower temperatures, the quantitative relationship being consistent with Hall effect measurements. Accumulation of polarization was reduced by irradiation with red light or by elevation of temperature; at 420°K little sign of polarization remained. From various temperature effects, the thermal depths of the trapping levels in these diamonds were estimated at 0.6, 0.8 and 1 eV. A.

537.542 : 539.185.9

4464. NEUTRON BOMBARDMENT OF COUNTING DIAMONDS. A.H.B.Benny and F.C.Champion.
Proc. Roy. Soc. A, Vol. 234, 432-40 (Feb. 21, 1956).

Several counting diamonds were exposed to nuclear radiations in a nuclear reactor. The counting efficiency is reduced approximately in proportion to the radiation dosage; a corresponding increase occurs in the optical absorption. Annealing at red heat leads only to partial recovery in both counting and optical transparency. Examination was also made of the effect of neutron bombardment on pulse-height distribution when recording α-particles of homogeneous energy by a diamond counter, used as a solid ionization chamber. The results are interpreted in terms of intrinsic charge traps and of additional charge traps produced by the neutrons. The layered crystal texture disclosed agrees with that already proposed by Champion from earlier counter work and by Pandya and Tolansky (1954) from an interferometric investigation of etch. A.

537.542

4465. A PULSE HEIGHT ANALYZER WITH AN ELECTRON BEAM TUBE. V.G.Khartman, I.N.Leont'eva, A.P.Sinyavskiĭ and L.V.Vasil'ev.
Zh. eksper. teor. Fiz., Vol. 28, No. 6, 699-705 (1955). In Russian. English translation in Soviet Physics JETP (New York), Vol. 1, No. 3, 537-45 (Nov., 1955).

The apparatus can sort into 20 channels positive pulses with amplitudes up to 100 volts, a rise time greater than 0.1 microsecond and a duration less than 30 microseconds. With a counting rate of 17 000 counts per minute, the loss is approximately 1%. The stability of the thresholds of the channels ~ 2%. A.

IONIZATION. THERMIONICS 537.56/58

537.562

4466. THE SPECIFIC PRIMARY IONIZATION IN GASES BY ELECTRONS OF MEDIUM ENERGY. II. K.Sommermeyer and H.Dresel.
Z. Phys., Vol. 144, No. 4, 388-95 (1956). In German.

Extends previous work (Pt I, Abstr. 8872/1955) to measurements in water vapour, CO_2, SO_2, NH_3 and hydrocarbons.
J.Dutton

537.564

4467. ON THE STATISTICS OF ELECTRON AVALANCHES IN A UNIFORM FIELD. L.Frommhold.
Z. Phys., Vol. 144, No. 4, 396-410 (1956). In German.

A detailed account is given of an experimental investigation of the statistical fluctuations of the number of ion pairs in an electron avalanche in alcohol vapour under constant electric field strength, pressure and electrode separation. The principle of the method used is to measure the change in potential between the electrodes due to the development of the avalanche. The results (giving the Townsend α-coefficient and its distribution function) are compared with those of other workers. C.G.Morgan

537.564 : 537.52

4468. A STUDY OF IONIZATION COEFFICIENTS AND

ELECTRICAL BREAKDOWN IN HYDROGEN. W.Hopwood, N.J.Peacock and A.Wilkes.
Proc. Roy. Soc. A, Vol. 235, 334-48 (May 8, 1956).

Experimental measurements of the Townsend ionization coefficient α for hydrogen have been made from a study of pre-breakdown currents in uniform electric fields over a range of the parameter E/p from 15 to 40 V/cm mm Hg. The results indicate that earlier measurements may be in error below E/p = 25 V/cm mm Hg, and show good agreement with the theoretical calculations of Emeléus, Lunt and Meek (1936) which are based on a Maxwellian distribution of electron energies. Furthermore, measurements made at different gas pressures for the same value of the parameter E/p show that α/p is a function of E/p. The growth of pre-breakdown currents has been measured to within a small percentage of the sparking distance and is found to be well represented by the Townsend equation

$$i = i_0 \frac{e^{\alpha d}}{1 - \gamma(e^{\alpha d} - 1)},$$

showing the existence of a secondary ionization mechanism denoted by γ. The results are discussed in the light of existing theories of electrical breakdown, and it is concluded that the Townsend mechanism is sufficient to explain the initiation of breakdown in hydrogen up to a pd value of at least 2800 cm mm Hg. A.

537.568

4469. THE DETACHMENT OF ELECTRONS FROM NEGATIVE IONS. J.B.Hasted and R.A.Smith.
Proc. Roy. Soc. A, Vol. 235, 349-53 (May 8, 1956).

Measurements have been made of collision detachment cross-sections for O^- in O_2, N_2, H_2O, H^- in H_2O, O_2^- in O_2 and Cl^- in Cl_2 between 10 and 2500 eV. Values obtained, $\sim 5 \times 10^{-16}$ cm^2 at 10 eV, make it likely that this detachment process is of significance in the removal of negative ions from positive columns of discharges where such energies may be found. It is possible to distinguish qualitatively between a detachment and a charge transfer collision, and in all cases studied except O_2^- in O_2, the charge transfer is found to be negligible. A.

537.568

4470. PARTIAL CHARGE TRANSFER OF DOUBLY CHARGED IONS. J.B.Hasted and R.A.Smith.
Proc. Roy. Soc. A, Vol. 235, 354-8 (May 8, 1956).

Measurements of the partial charge transfer cross-sections for doubly charged ions $X^{2+} + Y \rightarrow Y^+ + X^+$ are described for C^{2+}, N^{2+}, A^{2+} in He, Ne, A, and the results are discussed in terms of divergence from near-adiabatic conditions caused by the crossing of potential energy curves. The single endothermic case C^{2+} in He behaves adiabatically; all the others, which are exothermic, show large cross-sections at low energies. In the case A^{2+} in A there is a contribution from double charge transfer, which cannot be distinguished experimentally from partial charge transfer. A.

537.583 : 621.385.2.032.213.13

4471. THEORETICAL BASIS FOR MEASURING THE SATURATION EMISSION OF HIGHLY EMITTING CATHODES UNDER SPACE-CHARGE-LIMITED CONDITIONS. C.R.Crowell.
J. appl. Phys., Vol. 26, No. 11, 1353-6 (Nov., 1955).

The second derivative of the current-voltage relationship of an ideal plane diode is calculated from the Epstein–Fry–Langmuir analysis. From this analysis it is shown that the large saturation emissions characteristic of oxide-coated cathodes at normal operating temperatures, the current at the inflection point (i.e., the zero of the second derivative) is a sensitive measure of the saturation emission and is unaffected by the existence of a linear interface impedance. It is also shown that the general features of the results apply to cylindrical diodes. A.

537.58

4472. ON THE DESORPTION OF POSITIVE AND NEGATIV IONS BY STRONG ELECTRIC FIELDS. F.Kirchner and H.A.Ritter.
Z. Naturforsch., Vol. 11a, No. 1, 35-7 (1956). In German.

An investigation of the removal of Ca and Cl ions from a layer of calcium chloride absorbed on the tungsten point of an emission microscope; it is found that fields only fractionally greater than those commonly used in emission microscopy ar effective. The removal of Ca increases, that of Cl decreases the effective work function of the surface. For monomolecular films, Cl atoms could not be removed by the application of the maximum available field strength, an effect attributed to the retention of Cl, immediately adjacent to the tungsten, in atom rather than molecular form. E.A.As

COSMIC RAYS 537.591

537.591.1

4473. THE ASYMPTOTIC BEHAVIOUR OF THE PROBABILITY DISTRIBUTION FUNCTION OF COSMIC CASCADES. J.Łopuszański.
Acta phys. Polon., Vol. 14, No. 3, 265-7 (1955).

EVALUATION OF THE PROBABILITY DISTRIBUTIO FUNCTION OF COSMIC CASCADES FOR LARGE DEPTH OF THE ABSORBER. J.Łopuszański.
Acta phys. Polon., Vol. 14, No. 3, 269-71 (1955).

A preliminary treatment of the problem dealt with more fully in the following three abstracts. R.H.W.Johnston

537.591.1

4474. SOME REMARKS ON THE ASYMPTOTIC BEHAVIOU OF THE COSMIC RAY CASCADE FOR LARGE DEPTH OF THE ABSORBER. I. ESTIMATION OF FACTORIAL MOMENT. K.Urbanik.
Nuovo Cimento Suppl. (Ser. 10), Vol. 2, No. 4, 1147-50 (1955).

The usual Mellin integral expressions not being suitable, an asymptotic form is derived which is valid at large depths. It is shown that if $S_k(\epsilon, x) = \sum_{n=k}^{\epsilon^{-1}} n(n-1)\ldots(n-k+1)\, P(n|\epsilon, x$ is the k th factorial moment in the Janossy (Abstr. 4336/1950, 4197/1953) cascade theory, $P(n|\epsilon, x)$ denoting the probability that at depths x there are n nucleons of energy $> \epsilon$ due to one primary nucleon of unit energy, then for $0 < \epsilon < 1$ and $k = 1, 2\ldots \epsilon^{-1}$: $S_k(\epsilon, x) = \exp(-k)W_k(\epsilon, x)$, where for $\beta > 0$

$$\lim_{x \to \infty} \{\exp(-\beta x)W_k(\epsilon, x)\} = 0$$

and

$$\lim_{x \to \infty} W_k(\epsilon, x) = \infty$$

R.H.W.Johnstor

537.591.1

4475. SOME REMARKS ON THE ASYMPTOTIC BEHAVIOU OF THE COSMIC RAY CASCADE FOR LARGE DEPTH OF THE ABSORBER. II. ASYMPTOTIC BEHAVIOUR OF THE PROBABILITY DISTRIBUTION FUNCTION. J.Łopuszański.
Nuovo Cimento Suppl. (Ser. 10), Vol. 2, No. 4, 1150-60 (1955).

The development of the nucleon cascade is normally described by an integral equation of Janossy (Abstr. 4336/1950) (the G-equation, $G(\epsilon, u, x)$ being the probability generating func tion) which is solved by a recurrence relation yielding a solution $\Gamma_n(\epsilon, u, x)$ in terms of the S_k (see Pt I) and the collision cross-sections. This however is not amenable to numerical calculation. Instead, an integral equation for $\Gamma = \lim_{n \to \infty} \Gamma_n$ (which is equivalent to the G-equation) is investigated with regard to asymptotic behaviour. Using the result of Pt I, it is shown that, for large x, $P(0|\epsilon, x) \cong 1$, $P(1|\epsilon, x) \cong S_1(\epsilon, x)$ and $P(n|\epsilon, x) = o\{P(1|\epsilon, x)\}$ for $n > 1$. Thus for large x if ther

occurs at least one nucleon of energy $> \epsilon$ then there is only one such nucleon and it lies in the energy region $(\epsilon, \epsilon + d\epsilon)$.
R.H.W.Johnston

537.591.15

4476. SOME REMARKS ON THE ASYMPTOTIC BEHAVIOUR OF THE COSMIC RAY CASCADE FOR LARGE DEPTH OF THE ABSORBER. III. EVALUATION OF THE DISTRIBUTION FUNCTION. J.Łopuszański.
Nuovo Cimento Suppl. (Ser. 10), Vol. 2, No. 4, 1161-7 (1955).

The result of Pt II being regarded as a first approximation for large but finite depth, higher order approximations are derived. Using the Γ-equation of Pt II and solving by iteration it is shown that $\lim_{x \to \infty} \{S_n(\epsilon, x)/S_m(\epsilon, x)\} = 0$ for $n > m$ and $\epsilon > 0$. Expanding $P(l|\epsilon, x)$ in terms of the S_k it is shown that $P(n|\epsilon, x) \simeq \frac{1}{n!} S_n(\epsilon, x)$ and $P(n|\epsilon, x) = o\{P(m|\epsilon, x)\}$ for $n > m$. Thus for large x the terms of the Γ expansion represent the successive approximation steps. The method is expected to be of practical use in computation. It can be generalized for finite absorbers as well as for the electron-photon cascade.
R.H.W.Johnston

537.591.15

4477. A VARIATION OF THE RATE OF PENETRATING EXTENSIVE SHOWERS WITH SIDEREAL TIME.
C.B.A.McCusker.
Nuovo Cimento (Ser. 10), Vol. 2, No.6, 1340-1 (Dec., 1955).

Improving earlier results obtained with a penetrating-extensive-shower counter set under different lead thicknesses (Abstr. 8066/1955), a year's run under 20 cm of lead was analysed with respect to sidereal time. A χ^2 test on the null hypothesis gives P = 0.001. A seasonal solar time variation could produce a spurious sidereal variation; such an effect would also be present for anti-sidereal time. Analysing the results with respect to anti-sidereal time gave P = 0.7 for the null hypothesis. The amplitude (crest-trough) of the variation is 48 ± 13% of the average rate. With the same apparatus a solar time variation of both local penetrating showers and high-density electron showers has been detected (to be published).
R.H.W.Johnston

537.591.15

4478. CLOUD CHAMBER STUDY OF COSMIC RAY ELECTRONIC SHOWERS UNDER DENSE MATERIALS. II.
G.Di Caporiacco and M.Giovannozzi.
Nuovo Cimento (Ser. 10), Vol. 3, No. 2, 305-17 (Feb., 1956).

For Pt I, see Abstr. 8491 (1953). Pictures have been taken by means of a counter-controlled cloud chamber on electronic showers produced in lead plates 1, 3 and 4 cm thick. The angular distribution of tracks has been compared with the calculations of Roberg and Nordheim and of Franchetti and Giovannozzi. The distribution of showers as a function of the number of electrons has been used to check the results give by Jánossy and Messel and by Arley. A.

537.591.15

4479. TIME STRUCTURE OF COSMIC-RAY SHOWERS.
R.Sugarman and S.DeBenedetti.
Phys. Rev., Vol. 102, No. 3, 857-61 (May 1, 1956).

The time structure of extensive air showers at sea level has been measured by coincidence of liquid scintillation detectors and auxiliary Geiger tubes. The standard time deviation relative to the mean of single electrons is found to be 2 ± 2 mμ sec; the same quantity for single particles capable of penetrating 20 cm of Pb is 6 ± 2 mμ sec. The mean delay of penetrating particles relative to electrons is 0.9 ± 1.3 mμ sec. A.

537.591.2

4480. SPEED MEASUREMENT OF COSMIC-RAY PARTICLES USING MILLIMICROSECOND TIMING CIRCUIT. C.N.Chou.
Phys. Rev., Vol. 102, No. 3, 848-50 (May 1, 1956).

The speed of cosmic-ray particles was measured using a three-channel time-interval-measuring modified chronotron circuit. Results concerning μ-mesons agree with those theoretically expected. For cosmic-ray particles of speeds higher than 0.64 ? that of light, about 1.5 + 0.8% of high-speed ionizing particles (excluding electrons) at sea level are protons. A.

537.591.5

4481. COSMIC-RAY OBSERVATIONS AT VERY HIGH ALTITUDES DURING PERIODS OF INTENSE SOLAR ACTIVITY. M.A.Pomerantz.
Phys. Rev., Vol. 102, No. 3, 870-8 (May 1, 1956).

The records of a number of balloon flights which coincided with outstanding solar disturbances during the period 1947-1952 have been subjected to detailed statistical analysis in a search for associated fluctuations in the primary cosmic-ray flux. The intensity at very high altitudes was enhanced in four cases, and normal on five occasions when r.f. radio disturbances and/or visually-observed solar flares occurred. In some instances, outstanding chromospheric eruptions are not accompanied by any detectable increase in the flux of primary cosmic-ray particles even down to the very low energy required for just penetrating 10 g/cm^2 of matter. On the other hand, additional low-energy particles apparently associated with solar disturbances sometimes are detected at very high altitudes, even when the flares are small and the observing station is outside the morning impact zone. A.

537.591.8

4482. GENERATION OF THE SOFT COMPONENT OF THE COSMIC RADIATION IN LEAD. P.H.Stoker.
Phys. Rev., Vol. 102, No. 2, 516 (April 15, 1956).

The Rossi transition curve as obtained for the soft component of the cosmic radiation in the atmosphere, is compared with the curves obtained with a 10 cm absorbing lead layer just above and 86 cm above a counter arrangement. The stronger maximum of the curve obtained with the lead layer in the higher position may be attributed to unstable neutral particles emerging from the lead layer. A.

537.591.8 : 539.172.13

TRITIUM PRODUCTION BY HIGH ENERGY PROTONS.
See Abstr. 3983

MAGNETISM 538

538.082.743

4483. A MAGNETIC DIFFERENTIAL PROBE. ITS EMPLOYMENT FOR THE DETERMINATION OF THE STATIC MEDIAN MAGNETIC SURFACE IN THE GAP OF A SYNCHROTRON. G.D.Palazzi.
Nuovo Cimento (Ser. 10), Vol. 3, No. 2, 336-49 (Feb., 1956).

A differential magnetic probe, developed for determining the median magnetic surface of the static field in a weak-focusing synchrotron gap, is described. The probe consists of two thin ferromagnetic wires subjected to equal and opposite alternating magnetic fields at 1000 Hz. The method of measurement consists in determining the position of the probe for which the components of the magnetic field along the two wires (parallel to the radius of the synchrotron and lying in a vertical plane) are equal and opposite. The arrangement described gives the localisation of the median magnetic surface within ± 1 mm in static fields between 20 and 500 gauss. The possibility is also mentioned of measuring the field index n by means of this probe with an accuracy of 5% in fields not exceeding 500 gauss. Finally the technique used for preparing the ferromagnetic wires is explained in some detail. A.

538.1 : 538.22

4484. SUPER-EXCHANGE AND THE MAGNETIC PROPERTIES OF PALLADIUM BETWEEN 80 AND 1600°K. J.Wucher.
C.R. Acad. Sci. (Paris), Vol. 242, No. 9, 1143-5 (Feb. 27, 1956). In French.

Results of measurements of the magnetic susceptibility of palladium from 757 to 1649°K are given. Previously published values, over smaller temperature ranges, are in good agreement with one another but the theoretical interpretation, particularly of the maximum at 80°K, is not satisfactory. A theory of super-exchange between nearest neighbours is now proposed. An equation for the susceptibility as a function of T is given, having only one adjustable parameter; this may be chosen to give a good representation of the observed values. One term of the whole expression has a maximum at 80°K and it is suggested that this gives an interpretation of the observed maximum at this temperature. F.E.Hoare

538.113 : 539.11

4485. NUMBER OF STATES AND THE MAGNETIC PROPERTIES OF AN ELECTRON GAS. A.W.Sáenz and R.C.O'Rourke. Rev. mod. Phys., Vol. 27, No. 4 (I), 381-98 (Oct., 1955).

The number of energy states with energy less than E, N(E), is obtained from the spurs of exponential operators involving the spin-independent Hamiltonian operator. Two methods are used, one based on a formula due to Schwinger and the other using a method of expanding the operators. The methods are applied to the calculation of N(E) of nearly free electrons in metals and of free electrons in a magnetic field, giving expressions for the diamagnetic susceptibility. E.P.Wohlfarth

538.114

4486. THERMODYNAMICAL THEORY OF MAGNETIC RELAXATION. G.R.Khutsishvili. Zh. éksper. teor. Fiz., Vol. 29, No. 3(9), 329-33 (1955). In Russian.

The thermodynamical consideration of the magnetic relaxation processes is based on the use of the principle of the symmetry of the kinetic coefficients and yields the time-relation of magnetization and internal temperature of the spin-system. The author considers the conditions under which internal spin-equilibrium is attained much earlier than equilibrium of the spin system with the lattice.

Electrical Research Association

538.114 : 519.2

4487. ON METASTABLE APPROXIMATIONS IN CO-OPERATIVE ASSEMBLIES. C.Domb and M.F.Sykes. Proc. Roy. Soc. A, Vol. 235, 247-59 (April 24, 1956).

The exact solution of the three-dimensional Ising model of a ferromagnetic presents difficulties of a very fundamental nature. It therefore seems that the most reliable information on the behaviour of the model is provided by exact series expansions of the partition function at low and high temperatures. However, the usual low-temperature expansion fails to converge in the neighbourhood of the critical point. By rearranging the terms of the series on the basis of physical considerations, it is possible to obtain a systematic set of successive approximations, each approximation taking exact account of clusters of a given size or less (metastable approximations). By extrapolation accurate estimates can be derived of the Curie point and critical values of the energy and entropy. It is found that there is a marked difference in behaviour between two- and three-dimensional lattices, a far larger proportion of the entropy change taking place in the temperature region below the Curie point in the latter case. The corresponding specific heat curves are therefore much closer to those observed experimentally. Finally, a brief discussion is given of the dependence of the specific heat curve on lattice structure. A.

538.114 : 539.185

4488. THEORY OF NEUTRON SCATTERING BY CONDUCTION ELECTRONS IN A METAL AND ON THE COLLECTIVE-ELECTRON MODEL OF A FERROMAGNET. R.J.Elliott. Proc. Roy. Soc. A, Vol. 235, 289-304 (May 8, 1956).

The cross-sections are studied for the magnetic scattering of slow neutrons by metallic electrons whose energy states are described by band theory. It is found that both electron spin and current contribute to the scattering. With the aid of certain simplifying assumptions numerical results are obtained for two cases, the free-electron model of a simple metal like sodium, and the collective-electron model of a ferromagnet with particular reference to specific experimental data on iron. Scattering takes place over wide angles and is very weak, although total cross-sections may be of the order of millibarns. Unfortunately, therefore, this technique cannot at present give much information about the electrons. The predictions of the collective-electron model of a ferromagnet are of importance for comparison with experiment and the predictions of the other models. It is here contrasted in detail with the spin-wave predictions. A.

538.114 : 539.185

4489. SPIN FLUCTUATION SCATTERING OF NEUTRONS AND THE FERROMAGNETIC STATE IN IRON. R.D.Lowde. Proc. Roy. Soc. A, Vol. 235, 305-20 (May 8, 1956).

The theory and practice of neutron diffuse reflection (see preceding abstract) is applied to the question: what theoretical model of ferromagnetism is most apposite in the case of iron? Experimental results on the response of diffusely reflected intensity to the magnetization of an iron crystal at room temperature and at 907°K are interpreted as excluding the collective-electron representation, and indicating that the Heisenberg-type, localized-electron model is much closer to the truth. From the fit obtained between the observations and the predictions of the localized-electron model it is suggested that the magnetic electrons in iron vibrate under thermal agitation with measurably less than the nuclear amplitude. A

538.12 : 538.222 : 621.317.4

4490. ABSOLUTE MEASUREMENT OF MAGNETIC FIELDS BY ELECTRON RESONANCE. CALIBRATION OF HELMHOLTZ COILS. R.Gabillard and C.Germain. Onde élect., Vol. 35, 495-7 (May, 1955). In French.

The two coils are 36 cm o.d. and spaced 13.5 cm apart. A small sample placed at the centre of the system is also excited by an incremental field controlled by an oscillator due to Gabillard (Abstr. 1462/1954). Resonance in the system is determined by observing a differentiated form of the sample response against the oscillator output as sweep. The measured coil constant differs from the theoretical value by 0.1%. A careful analysis is made of the various sources of parasitic field and it is concluded that brass coil supports may be appreciably magnetic, due no doubt to ferromagnetic impurities.

S.C.Dunn (R)

538.221/.222

4491. CLEARLY DEFINED FERROMAGNETISM INDUCED BY THE ADDITION OF LITHIUM IONS IN NICKEL OXIDE. N.Perakis, A.Serres, G.Parravano and J.Wucher. C.R. Acad. Sci. (Paris), Vol. 242, No. 10, 1275-7 (March 5, 1956). In French.

The susceptibility of NiO, containing Li ions with concentrations 10^{20} to 10^{21} cm^{-3}, measured over the temperature range 80° to 1100°K, was found to be field-dependent over part of the range. E.P.Wohlfarth

538.221/.222 : 621.317.4.029.6

4492. APPARATUS FOR STUDYING PARAMAGNETIC AND FERROMAGNETIC RESONANCE AT 9000 Mc/s. J.Paulevé. Onde élect., Vol. 35, 494-5 (May, 1955). In French.

A frequency-stabilized 2K25 klystron feeds a magic T one arm of which carries a detector and another a resonant cavity. The cavity contains a small spherical sample and is subject to a steady polarizing field. The klystron output is amplitude-modulated to a depth of about 20% at 300 c/s by a crystal shunting the waveguide. A synchronous detector is also switched at 300 c/s and the output recorded. A ferrite sample 0.05 mm dia. causes an absorption which is detected as a change in Q of 1%. Variations in Q of 1 part in 10^4 are detectable. S.C.Dunn

538.221

4493. RESONANCE OF FERRITES AT THE COMPENSATION POINT, USING CIRCULARLY POLARIZED FIELDS (FERRIMAGNETIC RESONANCE). J.Paulevé and B.Dreyfus. C.R. Acad. Sci. (Paris), Vol. 242, No. 10, 1273-5 (March 5, 1956). In French.

Reports results of measurements at 9.4 kMc/s on the substances $Li_{0.5}\ Fe_{2.5-a}\ Cr_aO_4$ (a = 1.25, 1.5) over a temperature range including the compensation and Curie points. Ferromagnetic and exchange resonances were observed in different parts of the range. E.P.Wohlfarth

538.221

4494. EFFECT OF HEAT TREATMENT ON THE COERCIVE FORCE OF FERRUGINOUS MANGANESE ORES. B.S.R.Rao and V.L.S.Bhimasankaram. Curr. Sci., Vol. 24, No. 8, 261-2 (Aug., 1955).

Specimens containing 41% Mn, 18% Fe were annealed at temperatures between 300° and 900° C and the coercivity was found to be largest (180 oersted) for an annealing temperature 600° C. See also Abstr. 2572 (1954). E.P.Wohlfarth

538.221

4495. INVESTIGATION OF THE MAGNETIC STRUCTURE OF SILICON-IRON CRYSTALS BY THE POWDER METHOD. Ya. S. Shur and V.R.Abel's. Dokl. Akad, Nauk SSSR, Vol. 104, No. 2, 209-10 (1955). In Russian.

Crystal surfaces coinciding with the crystallographic planes (100) or (110) consist entirely of fundamental domains in which the magnetization vector is parallel to the direction of easy magnetization near the specimen surface (type A domains). Re-entrant domains occur at the ends of the fundamental domains. Where the surface consists of re-entrant domains, the fundamental domains are inside the specimen (B-structure). Combinations of both types are possible. Electrical Research Association

538.221

4496. REPRESENTATION OF THE DOMAINS OF A FERROMAGNETIC BY THE ELECTRON-OPTICAL METHOD. G.V.Spivak, N.G.Kanavina, I.S.Sbitnikova and T.N.Dombrovskaya. Dokl. Akad, Nauk SSSR, Vol. 105, No. 4, 706-8 (1955). In Russian.

The method of reproducing magnetic inhomogeneities of a metal surface by the focusing effect of magnetic 'micro-lenses' enables regions of inhomogeneous magnetization of the size of 0.1 mm to be investigated. Different contrast effects are obtained according to the choice of the plane of focusing. The pictures shown were obtained on a cobalt monocrystal used as cathode and correspond closely to a domain-representation obtained by the powder method and used for comparison. Electrical Research Association

538.221

4497. MAGNETIC CONTRAST IN AN ELECTRON MIRROR AND OBSERVATION OF THE DOMAINS OF A FERROMAGNETIC. G.V.Spivak, I.N.Prilezhaeva and V.K.Azovtsev. Dokl. Akad. Nauk SSSR, Vol. 105, No. 5, 965-7 (1955). In Russian.

An interesting new development of the method of the electron mirror was used by the authors for investigations of contrast effects between ferromagnetics and non-magnetic materials (magnetic contrast effects) and also for investigations of the domain structure of ferromagnetics. Very clear pictures are obtainable at magnifications up to 150 x; four such pictures are reproduced in the paper. Electrical Research Association

538.221

4498. VARIATION OF THE MAGNETIC ANISOTROPY ENERGY OF Ni AND OF Ni-Cu ALLOYS AS A FUNCTION OF THE TEMPERATURE. M.Sato and Y.Tino. J. Phys. Radium, Vol. 17, No. 1, 5-8 (Jan., 1956). In French.

By consideration of the magnetic interactions between neighbouring atoms, a simple theoretical explanation is given of the variation with temperature of the first anisotropy constant for nickel and nickel–copper alloys. The relation obtained is formally identical with the empirical relation given by Brukhatov and Kirensky, $K_1 = K_{10} \exp(-\alpha T^2)$. A.E.De Barr

538.221

4499. SOME FURTHER DETAILS OF THE ANTIFERROMAGNETIC RESONANCE DIAGRAM IN $CuCl_2.2H_2O$ AT 9500 MHz. M.Garber and H.J.Gerritsen. Physica, Vol. 22, No. 3, 189-93 (March, 1956).

Minor discrepancies are observed between careful resonance field measurements at 9500 Mc/s and the predictions of the molecular field theory. No explanation is proposed for these discrepancies. A.

538.221

4500. MEASUREMENTS ON THE INTENSITY OF THE RESONANCE ABSORPTION IN $CuCl_2.2H_2O$ AT 9400 MHz. H.J.Gerritsen and M.Garber. Physica, Vol. 22, No. 3, 197-207 (March, 1956).

The intensity of the antiferromagnetic resonance absorption was measured at different temperatures as a function of the relative orientation of the static field H, the high frequency field h, and the crystal axes. At the lowest temperatures and with H along the a-axis, there is no absorption when h is parallel with the a-axis, and the absorption is maximal when h is along the b-axis. At higher temperatures the lower resonance line H_L, is excited predominantly by components of h along the c-axis, while the higher resonance line, H_H, is excited predominantly by components of h along the a-axis. The intensity of the antiferromagnetic resonance lines was the same order as that usually encountered in paramagnetic resonance at low temperatures. Reasonably good quantitative agreement is found between the detailed measurements and calculations based on the classical field model, as will be described in a forthcoming paper. A.

538.221

4501. ANTIFERROMAGNETIC RESONANCE LINE WIDTHS IN $CuCl_2.2H_2O$ AT 9400 MHz. H.J.Gerritsen, M.Garber and G.W.J.Drewes. Physica, Vol. 22, No. 3, 213-23 (March, 1956).

Linewidth measurements in the 3 cm antiferromagnetic resonance of copper chloride are described. These data supplement the detailed studies already made on the resonance diagrams. While the latter are fairly well explained by the molecular field models of Ubbink and of Yosida and Nagamiya, there is as yet not theory for the linewidths. A.

538.221

4502. METHODS OF DETERMINING THE CONSTANT S_V OF THE IRREVERSIBLE MAGNETIC AFTER-EFFECT. O.Yamada and H.D.Hahlbohm. Z. angew. Phys., Vol. 8, No. 4, 205-8 (1956). In German.

After reviewing various methods it is suggested that the most reliable results are obtained by measuring the apparent total and reversible differential susceptibilities of a specimen with known demagnetizing factor, as well as the magnetization change in a given time interval. E.P.Wohlfarth

538.221 : 538.652

4503. THEORY OF THE MAGNETOSTRICTION OF Ni MONOCRYSTALS. N.S.Akulov. Dokl. Akad. Nauk SSSR, Vol. 106, No. 1, 31-4 (1956). In Russian.

The author's law of magnetic anisotropy (1928), successfully applied to the calculation of the magnetostriction of crystals with six directions of spontaneous magnetization, assumes successive occurrence of longitudinal and transverse inversions. An analysis of the spin transitions to which these inversions are due, in the case of a field parallel to the trigonal crystal axis, shows that they may be simultaneous, which enables the magnetostriction of crystals with eight

directions of spontaneous magnetization to be calculated.
Electrical Research Association

538.222

4504. ANTIFERROMAGNETISM IN THE SYSTEM Ti–H. E.P.Wohlfarth.
Acta metall., Vol. 4, No. 2, 225-7 (March, 1956).

The experimental results of Trzebiatowski and Staliński (Abstr. 4715/1954) on the paramagnetic susceptibilities of titanium hydrides are tentatively interpreted. The observed susceptibility maxima at concentrations H/Ti above about 1.5 are ascribed to the antiferromagnetism of the phase TiH_2, arising as a result of superexchange interaction between Ti atoms through the intermediary of molecular hydrogen.
E.P.Wohlfarth

538.222

4505. THE METHODS OF PARAMAGNETIC RESONANCE. A.Kastler.
Cahiers de Phys., No. 65, 1-19 (Jan., 1956). In French.

A review of magnetic resonance experiments on atomic and molecular beams, principally those of Rabi and collaborators.
D.H.Whiffen

538.222

4506. PARAMAGNETIC RESONANCE OF COLOR CENTERS IN $NaNO_3$. W.B.Ard, Jr.
J. chem. Phys., Vol. 23, No. 10, 1967-8 (Oct., 1955).

Two sets of resonance lines were found, one with three equally spaced equal-intensity lines independent of field strength or orientation with $g = 2.000 \pm 0.003$. These lines are assumed to be due to coupling with the N^{14} nucleus. The other set of lines changes with field orientation and only one line occurs if the coloration and measurements are at 77°K. The latter lines are unlikely to be due to F-centres.
G.F.J.Garlick

538.222

4507. DEVIATIONS FROM THE CURIE–WEISS LAW IN CUPRIC COMPOUNDS. N.Perakis, A.Serres and T.Karantassis.
J.Phys. Radium, Vol. 17, No. 2, 134-9 (Feb., 1956). In French.

Reports susceptibility measurements on $CuCl_2$, $CuBr_2$, CuO and $Cu(CH_3COO)_2 \cdot H_2O$ between 90° and 1200°K. Susceptibility maxima were observed at varying temperatures, followed at higher temperatures by Curie–Weiss behaviour with Curie constant 0.45 and varying negative Curie temperatures.
E.P.Wohlfarth

538.222

4508. PARAMAGNETIC ELECTRON RESONANCE IN "DONETZ" COAL. L.van Gerven, A.van Itterbeek and E.de Wolf.
J. Phys. Radium, Vol. 17, No. 2, 140-2 (Feb., 1956). In French.

A strong electron resonance signal is obtained from Donetz coal; its half width varies from 0.72 Oe at 2.0°K to 0.37 Oe at 293°K.
D.H.Whiffen

538.222

4509. MAGNETIC PROPERTIES OF BETA-URANIUM HYDRIDE. S.T.Lin and A.R.Kaufmann.
Phys. Rev., Vol. 102, No. 3, 640-6 (May 1, 1956).

The curve of reciprocal paramagnetic susceptibility against temperature generally follows the Curie–Weiss law and shows the same curvatures near the Curie point and at high temperatures as do the data for the ferromagnetic elements above their Curie points. A considerable number of magnetization curves have been obtained for a wide range of temperatures. Three methods were used for deducing the spontaneous magnetization for comparison. The curve of reduced spontaneous magnetization against reduced temperature lies very close to the curves of iron, nickel and cobalt. The paramagnetic Curie temperature, 173°K, is about 8°K lower than the ferromagnetic Curie point. The number of elec tron spins per molecule obtained from the saturation magnetization and from the temperature dependence of the paramagnetic susceptibility shows the same discrepancy as do the ferromagnetic elements. Three hystereses loops at about 161.1°K, 75°K and 4.2°K and the coercive forces from about 170°K down to 4.2°K have been obtained. The magnetocrystalline anisotropy constants for the whole low-temperature rang calculated from the magnetization curves and from the coerci forces agree in order of magnitude. A

538.22

4510. ON THE MAGNETIC PROPERTIES OF SOME HAEMOGLOBIN COMPLEXES. J.S.Griffith.
Proc. Roy. Soc. A, Vol. 235, 23-36 (April 10, 1956).

Most haemoglobin compounds fall satisfactorily into Pauling's classification of "ionic" and "covalent" complexes. A few, however, have surprising magnetic properties. In this paper interpretations of these properties are offered which enable all the compounds to be fitted into a theoretical scheme of the type which is adequate for an approximate understandin of simple inorganic complexes. In particular, it is suggested that: the oxygen molecule in oxyhaemoglobin is not at right angles to the haem but probably parallel to it; all ferrihaemoglobin derivatives have a spin of either $S = \frac{1}{2}$ or $S = \frac{5}{2}$ at each iron atom or, in the case of ferrihaemoglobin hydroxide, are a thermal equilibrium of the two; ferrihaemoglobin derivative with $S = \frac{5}{2}$ have usually or always a large zero-field splitting, the lowest states being characterized by $S_z = \pm \frac{1}{2}$ perpendicul to the haem. A

538.222 : 538.632 : 537.311.3

MAGNETIC AND ELECTRICAL PROPERTIES OF MANGANESE TELLURIDE. See Abstr. 3730

538.222 : 548.7 : 536.75

SUSCEPTIBILITY AND ENTROPY OF F-CENTERS IN ALKALI HALIDES BELOW 1°K. See Abstr. 3702

538.222 : 621.317.4.029.

4511. REALIZATION OF A HIGH-SENSITIVITY APPARATUS FOR PARAMAGNETIC ELECTRON RESONANCE AT 9200 Mc/s. J.Uebersfeld.
Onde élect., Vol. 35, 492-4 (May, 1955). In French.

The principle of the method is to observe the variation in Q of a resonant cavity containing the paramagnetic substance and immersed in a magnetic field. The cavity is connected to a magic T fed from a klystron with stable supplies. The refle ted power from the cavity is amplified and applied to the Y-plates of a c.r.o. The X-deflection is isochronous with the small modulating magnetic field which explores the sample. The minimum number of detectable paramagnetic centres is about 10^{16}.
S.C.Dun

538.22

4512. THE DIAMAGNETISM OF BENZENE. A.Pacault, B.Lemanceau and J.Joussot-Dubien.
C.R. Acad. Sci. (Paris), Vol. 242, No. 10, 1305-6 (March 5, 1956). In French.

A previously described apparatus (see Abstr. 2561/54) was used for the determination of the 3 main molar susceptibilities of the C_6H_6 crystal; the values obtained are: $-(65.2 \pm 0.9) \times 10^{-6}$, $-(37.9 \pm 0.9) \times 10^{-6}$, and $-(61.3 \pm 0.6) \times 10^{-6}$ c.g.s. units.
F.Lachma

538.23 : 538.22

4513. A RELATION BETWEEN THE JORDAN HYSTERESIS CONSTANT AND THE INITIAL PERMEABILITY [OF FERROMAGNETIC MEDIA]. III. FERRITE CORES WITH RECTANGULAR HYSTERESIS LOOP. IV. INFLUENCE OF THE COERCIVITY. M.Kornetzki.
Z. angew. Phys., Vol. 8, No. 3, 127-35 (1956). In German.

For Pt II, see Abstr. 2011 (1955). The value of h/μ of a Mn–Mg ferrite is over 10 times higher than the value for ferrites with normal loops and the same coercivity. The increase is due to a lower value of μ ascribed to pronounced magnetocrystalline anisotropy. For a wide range of ferromagnetic substances (see Pt II) it is shown that hH_c is approximately constant. E.P.Wohlfarth

538.24

4514. "CURIE POINT" MOTOR. G.J.Van der Maas and W.J.Purvis.
Amer. J. Phys., Vol. 24, No. 3, 176-7 (March, 1956).

538.24

4515. INFLUENCE OF PULSED MAGNETIC FIELDS ON THE REVERSAL OF MAGNETIZATION IN SQUARE-LOOP METALLIC TAPES. D.S.Rodbell and C.P.Bean.
J. appl. Phys., Vol. 26, No. 11, 1318-24 (Nov., 1955).

Reversal of magnetization in square-loop metallic tapes is described in terms of the domain geometry and the dependence of this geometry upon the applied magnetic field wave shape. For a steady field whose amplitude is slightly greater than the coercive force, the reversal is accomplished by growth of a single axial domain originating at the thin tape edge. For steady fields of much greater amplitude, the reversal domain grows in from all tape surfaces. Because of the finite nucleation time required to establish the reversal domain, short duration, high-amplitude field pulses can be used to investigate the mechanism of nucleation of the high field reversal domain configuration. A model which accounts for the nucleation process is suggested. The compatibility of this model with various experimental results is presented. From these results an understanding of the high field reversal-domain configurations and the kinetics of the nucleation and growth of these domains in lamellar materials is obtained. An auxiliary result obtained is the value of the "intrinsic mobility" of a domain wall which for a 65 Permalloy specimen is determined to be about 100 $cm.sec^{-1}.oe$. A.

538.24 : 548.736.4

STRUCTURE OF FERRIMAGNETIC FERRITES OF RARE EARTHS. See Abstr. 4111

538.247

4516. THE DEMAGNETIZATION BY ALTERNATING MAGNETIC FIELDS OF MAGNETITE AND α-IRON SESQUIOXIDE. F.Rimbert.
C.R. Acad. Sci. (Paris), Vol. 242, No. 7, 890-3 (Feb. 13, 1956). In French.

Shows how the isothermal remanence and the thermoremanence are reduced by an alternating field in the presence of an applied steady field. E.P.Wohlfarth

538.249

4517. INTERPRETATION OF DOMAIN PATTERNS RECENTLY FOUND IN BiMn AND SiFe ALLOYS. J.B.Goodenough.
Phys. Rev., Vol. 102, No. 2, 356-65 (April 15, 1956).

It is shown that in a demagnetized crystal in which closure domains do not form, the domain pattern on a surface perpendicular to the easy-magnetization axis varies with the thickness of the crystal. For thin crystals the domain configuration should consist of plane-parallel walls. As the thickness of the crystal is increased, the plane walls become undular to form a rickrack-type pattern, the amplitude of the waves increasing with increasing thickness. At greater thicknesses the domain pattern becomes more complicated, a characteristic feature being many small domains of reverse magnetization penetrating as spikes from the surface into the interior. A typical pattern for a demagnetized sample could consist of a regular pattern of reverse-domain spikes within large domains demarked by plane-parallel walls extending all the way through the crystal. These theoretical predictions are compared with domain patterns recently observed in BiMn alloys and in barium ferrite. Recently reported domain patterns in polycrystalline SiFe alloys are interpreted as representing the latter thick-crystal configuration. The significance of the patterns found in SiFe alloys for the theory of flux reversal is also discussed. A.

ELECTROMAGNETISM. ELECTRODYNAMICS 538.3/.5

538.3

4518. AN OBSERVATION ON THE SUPPLEMENTARY CONDITION OF ELECTRODYNAMICS. P.Bocchieri and A.Loinger.
Nuovo Cimento (Ser. 10), Vol. 3, No. 1, 221-2 (Jan., 1956). In Italian.

It is pointed out that Fermi's (1929) condition, replacing the Lorentz condition, implies an almost obvious difficulty, besides those already known. Also this new difficulty is eliminated by the method of Gupta and Bleuler, Abstr. 69 (1951). L.Pincherle

538.3 : 512.831

4519. DESCRIPTION OF THE ELECTROMAGNETIC FIELD BY MEANS OF MATRICES. G.A.Zaĭtsev.
Zh. éksper. teor. Fiz., Vol. 28, No. 5, 524-9 (1955). In Russian. English translation in Soviet Physics JETP (New York), Vol. 1, No. 3, 411-14 (Nov., 1955).

The characteristics of matrix-tensors are described. The equations of the electromagnetic field are given in matrix form. A.

538.54 : 538.221

4520. THE INTERNAL DAMPING OF ELASTIC VIBRATIONS DUE TO EDDY CURRENTS IN A MAGNETIC FIELD. P.Schiller.
Nuovo Cimento (Ser. 10), Vol. 2, No. 6, 1328-30 (Dec., 1955). In German.

The Q factor of Ni is shown to be proportional to $r\,f^{1/2}$, where r is the specimen radius and f the frequency. The effect is ascribed to macroscopic eddy currents. E.P.Wohlfarth

ELECTROMAGNETIC WAVES AND OSCILLATORS 538.56

538.56 : 532.5

4521. EIGEN OSCILLATIONS OF COMPRESSIBLE, IONIZED FLUIDS. R.E.Loughhead.
Austral. J. Phys., Vol. 8, No. 3, 416-18 (Sept., 1955).

It is shown that the frequencies of the small oscillations of a region of uniform magnetic field in a fluid of infinite conductivity may be derived quite simply from the hydromagnetic equations when the region is bounded by cylindrical or parallel plane surfaces. R.A.Newing

538.561 : 537.52

4522. TRAVELING DENSITY WAVES IN POSITIVE COLUMNS. S.Watanabe and N.L.Oleson.
Phys. Rev., Vol. 99, No. 6, 1701-4 (Sept. 15, 1955).

The continuity equations for positive ions and for electrons coupled to each other by the Coulomb force and the effect of ionizing collisions have a solution representing travelling density waves whose frequencies are widely different from the usual plasma oscillations. A.

538.565 : 621.372.413.013

4523. ON REPRESENTATION OF ELECTROMAGNETIC FIELDS IN CAVITIES IN TERMS OF NATURAL MODES OF OSCILLATION. S.A.Schelkunoff.
J. appl. Phys., Vol. 26, No. 10, 1231-5 (Oct., 1955).

A simple example is given to show that in order to express the admittance of a cavity excited through a hole in

terms of natural frequencies of oscillations which can exist when the cavity is short-circuited, it is important to remember that the short circuit must conform to the impressed field. When this is done, there is no danger that the "obvious" set of natural modes may be incomplete. A.

538.566

4524. PROPAGATION OF DISCONTINUITIES IN ELECTROMAGNETIC INTENSITIES AND PROOF OF UNIQUENESS FOR THE INITIAL VALUE PROBLEM FOR MAXWELL'S EQUATIONS. A.Rubinowicz.
Acta phys. Polon., Vol. 14, No. 3, 209-24 (1955). In German.

In an uncharged medium, let $\Delta\vec{E}$ and $\Delta\vec{H}$ be the discontinuities in the electric and magnetic intensities at a surface S, every point of which moves with velocity v in the direction of the normal to the surface. It is shown that in general there will be conduction currents in S, and that S will act as an energy source or sink. If these currents are zero, S makes no contribution to the energy balance of the field; in this case v is equal to the velocity of light $c/\sqrt{(\epsilon\mu)}$ and $\Delta\vec{E}$ and $\Delta\vec{H}$ are tangential to S. The uniqueness theorem is established for prescribed charge and convection current densities, $\Delta\vec{E}$ and $\Delta\vec{H}$ satisfying suitable conditions over fixed or moving surfaces. R.A.Newing

538.566

4525. THE LAW OF THE CONSERVATION OF MOMENTUM AND THE PROPAGATION OF DISCONTINUITIES IN ELECTROMAGNETIC INTENSITIES. A.Rubinowicz.
Acta phys. Polon., Vol. 14, No. 3, 225-31 (1955). In German.

The Minowski energy–momentum tensor for the electromagnetic field inside matter, but not that due to Abraham, is found consistent with the conservation of momentum in the case of a surface of discontinuity moving with normal velocity $c/\sqrt{(\epsilon\mu)}$. R.A.Newing

538.566 : 621.317.335.3 : 621.317.74

4526. A CENTIMETRE-WAVE PARALLEL-PLATE SPECTROMETER. P.H.Sollom and J.Brown.
Proc. Instn Elect. Engrs, Paper No. 2008 R, publ. May, 1956 (Vol. 103 B, 419-28).

A spectrometer has been designed for the measurement at a wavelength of 1.25 cm of the refractive index of samples formed into prisms. The radiation is totally enclosed by two parallel plates approximately 4 ft in diameter, $\frac{3}{16}$ in. apart, and enters the instrument by a sectoral horn free to move over a 90° sector of the circumference. The receiving aerial can be either a similar horn or an open-ended waveguide, and may be positioned anywhere on the circumference. The principles on which the instrument is designed are discussed, and details are given of the mechanical construction and of the tests made upon its accuracy. The electrical performance has been examined in a variety of ways, and it has been established that beam directions can be located to within 0.25°. Variations in the received signal power occur and are shown to arise from a variety of effects, such as plate spacing, aerial penetration into the plate region and interference by unwanted signals such as the transmitter side-lobes. None of these causes a significant change of the direction of the main beam. Measurements on polystyrene prisms show a 3% error in refractive index attributed to imperfect contact between the dielectric of the prism and the spectrometer plates. This error can be reduced to less than 0.5% by coating the prism surfaces with tin foil. A.

538.566

4527. RIGOROUS SOLUTION OF A PARTICULAR DIFFRACTION PROBLEM. P.Poincelot.
Ann. Télécomm., Vol. 11, No. 3, 50-6 (March, 1956). In French.

An infinitely thin, perfectly conducting, rectangular screen is considered, of infinite length. The electric vector is parallel to the sides. The field is written as the vector sum of the unimpeded field and of that radiated by the currents developed i the screen and is obtained by expanding the surface density in a Fourier series whose coefficients are determined by an infinite system of linear equations. L.Pincherle

538.56

4528. PROPAGATION OF E.M. WAVES THROUGH INHOMOGENEOUS LAYERS. H.-G.Haddenhorst.
Z. angew. Phys., Vol. 7, No. 10, 487-96 (1955). In German

Layers are considered in which the dielectric constant rises (a) linearly, (b) exponentially from the value 1 at both surfaces to a value ϵ_m in the middle. A theory is given of the dependence of the reflection coefficient of such layers on the thickness, angle of incidence and ϵ_m, for E both parallel and perpendicular to the plane of incidence. To verify this theory experiments were performed both in free space and in a wave guide. The inhomogeneity was produced by a periodic arrange ment of wedge-shaped homogeneous material. L.Pincherl

538.566 : 621.372.

4529. TRANSMISSION CHARACTERISTICS OF WAVES ON DIELECTRIC TUBES. H.G.Unger.
Fernmeldetech. Z. (FTZ), Vol. 8, No. 8, 438-43 (Aug., 195 In German.

Presents the results of a theoretical investigation. The guide wavelength, attenuation and field radius (at which the field strength is reduced to 1/e of its value at the tube surfac are presented in a series of graphs, as a function of tube diameter and wall thickness, for the E_{01}, H_{01} and HE_{11} modes It is concluded that the HE_{11} mode offers the best transmissic characteristics, and that the performance to be expected is significantly superior to that obtainable with a solid dielectri rod. E.A.As

538.566 : 621.372.

4530. ENERGY CONCENTRATION EFFECTS IN FERRITE LOADED WAVE GUIDES. J.L.Melchor, W.P.Ayres and P.H.Vartanian.
J. appl. Phys., Vol. 27, No. 1, 72-7 (Jan., 1956).

The primary objective was to determine the effects of geometric parameters on microwave transmission character istics for two counter-rotating circularly polarized waves in ferrite loaded waveguide. Ferrite rods were mounted coaxial in circular waveguide of 0.934 in. diameter. Effects of rod diameter and length were observed on reflection, phase shift or Faraday rotation, and ellipticity. Effects of frequency and applied magnetic field were observed in addition to differenc in energy concentration in a ferrite for the two circular wave A greater percentage of the microwave energy is found to be in the ferrite for one rotating component than the other. It is shown that Faraday rotation of large diameter rods cannot be used to characterize ferrites accurately. A

538.566 : 621.372.

4531. DIFFRACTION OF CENTIMETRIC WAVES IN A WAVEGUIDE BY A CONDUCTING SPHERE. W.Chambron.
J. Phys. Radium, Vol. 16, No. 11, 891-2 (Nov., 1955). In French.

Measurements at 9100 Mc/s in RG-52/U guide show that the relationship between reflection coefficient and sphere vol ume is closely linear for the volume range 0 to 20 mm^3. J.M.C.Duk

538.566 : 621.372.

4532. MAGNETO-OPTICAL PHENOMENA IN A RECTANGULAR WAVEGUIDE FILLED WITH ELECTRON GAS. A.L.Mikaélyan.
Radiotekhnika, Vol. 10, No. 9, 3-13 (1955). In Russian.

An electron gas under the action of a steady magnetic field has a tensor permittivity. The propagation constant for transmission of e.m. waves through such a magnetized gas between parallel plates is interpreted as representing an ordinary and an extraordinary wave. When the analysis is

extended to include the effect of the side walls of a waveguide It is shown that these waves correspond to H- and E-modes respectively. The partially filled guide is then treated. The behaviour depends on the direction of propagation and the possibility of making a "valve" in the waveguide is mentioned.
S.C.Dunn

538.566 : 621.385.1.029.6 : 621.396.677.45

4533. DEMONSTRATIONS OF ELECTROMAGNETIC WAVES IN HELICES. C.L.Andrews.
Amer. J. Phys., Vol. 24, No. 1, 11-14 (Jan., 1956).
Demonstrations of standing microwaves in helices are described for helix circumferences ranging from 0.1 to 3 wavelengths. Special attention is given to dimensions of helices used in (1) travelling-wave tubes as broadband amplifiers, (2) axial-mode aerials for producing a circularly polarized axial beam, and (3) radial-mode aerials for broadcasting a horizontally polarized radial beam. The demonstrations are made with 2450 Mc/s educational equipment. A.

538.566.2 : 550.38

4534. INFLUENCE OF THE EARTH'S HORIZONTAL MAGNETIC FIELD ON ELECTRIC WAVES BETWEEN THE EARTH AND IONOSPHERE, WHICH RUN OBLIQUELY TO THE MAGNETIC MERIDIAN. W.O.Schumann.
Z. angew. Phys., Vol. 8, No. 3, 126-7 (1956). In German.
In a continuation of earlier work with waves along and perpendicular to the magnetic meridian it is shown that two independent waves are possible which, through the two wave types, E and H, are coupled on account of boundary conditions. Expressions are obtained for the two waves and their phases and intensities are discussed. On this theory, the observations of Ratcliffe and others, on thunderstorms to SE and SW having different wave forms, are attributed, not to a special property of the distribution, but to the character of the electric charge, which is different over the ocean from over the continent.
R.S.Read

538.569.4 : 537.312.62

MILLIMETER WAVE ABSORPTION IN SUPERCONDUCTING ALUMINUM. See Abstr. 3752

MOLECULAR AND ATOMIC STRUCTURE 539.1

THEORY OF SOLID STATE 539.11

539.11

4535. SPHERICAL HARMONICS WITH THE SYMMETRY OF THE CLOSE-PACKED HEXAGONAL LATTICE. S.L.Altmann.
Proc. Phys. Soc. A, Vol. 69, Pt 2, 184-5 (Feb. 1, 1956).
A method has been developed for obtaining these spherical harmonics in polar coordinates, and the results are briefly given here. Some of them are at variance with those of Schiff (Abstr. 8945/1955). A.R.Stokes

539.11

4536. THE CELLULAR METHOD FOR CLOSE-PACKED HEXAGONAL TITANIUM. B.Schiff.
Proc. Phys. Soc. A, Vol. 69, Pt 2, 185-6 (Feb. 1, 1956).
See preceding abstract. Some corrections are made to the results given in a previous paper (Abstr. 8945/1955) on electron wave-functions. A.R.Stokes

539.11 : 537.311.31

4537. ELECTRON THEORETICAL INVESTIGATIONS OF DEFECTS IN METALS. I. LATTICE DEFECTS IN NICKEL, COBALT AND THEIR ALLOYS. A.Seeger.
Z. Phys., Vol. 144, No. 5, 637-47 (1956). In German.
Suggests that the charge carriers are the 4s electrons with spin parallel to the magnetization. The residual resistance in Ni due to vacancies is calculated from phase shifts. It is suggested that the vacancy energy as well as the cohesive energy of the metal itself is influenced strongly by d electron interaction. E.P.Wohlfarth

MOLECULES 539.13

539.13

4538. CALCULATION OF INTERMOLECULAR FORCE CONSTANTS FROM POLARIZABILITIES. W.Brandt.
J. chem. Phys., Vol. 24, No. 3, 501-6 (March, 1956).
Two quantum mechanical approximation formulae due to Slater and Kirkwood are modified empirically such as to relate the empirical intermolecular force constants of a two-parameter potential to the average polarizabilities and the number of valence electrons of the interacting molecules. Their usefulness is demonstrated in predicting the force constants of the Lennard-Jones (12-6) potential of fourteen nonpolar gas molecules and of one polyatomic group in a polymeric chain molecule. The limited applicability of the modified Slater–Kirkwood formulae to dipolar and/or nonspherically symmetric molecules is discussed. A.

539.13

4539. IODINE COMPLEXES IN INERT SOLVENTS. I. I_2–I_2 IN CARBON TETRACHLORIDE AND IN N-HEPTANE. P.A.D.de Maine.
J. chem. Phys., Vol. 24, No. 5, 1091-3 (May, 1956).
The shape of the ultraviolet absorption curve for the I_2–I_2 complex in CCl_4 and in n-heptane, has been obtained by analysis of the ultraviolet absorption of iodine dissolved in these pure solvents. In this analysis it has been necessary to assume that the assumed equilibrium constant, for the reaction $I_2 + I_2 \rightleftharpoons I_2 - I_2$, does not change with the wavelength. In carbon tetrachloride and in n-heptane the I_2–I_2 complex absorption maximum occurs near 2935 A, which is in good agreement with the value predicted by the McConnell, Platt and Ham relation. The heat of formation of this complex in CCl_4, has been estimated as 1.96 kcal/mole (within 0.15 kcal) by assuming that its molar extinction coefficient curve does not change with the temperature. The absorption spectrum of iodine dissolved in CCl_4 has been extended to 2250 A, and it has been shown that iodine–carbon tetrachloride solutions obey Beer's law below 2500 A, a region in which there is strong absorption by CCl_4 and no absorption by I_2–I_2. A.

539.132

4540. FORCE CONSTANTS OF BCl_3 MOLECULE. V.Santhamma.
Curr. Sci., Vol. 24, No. 8, 262-3 (Aug., 1955).
Valence force constants are determined from three known in-plane frequencies of $B^{11}Cl_3$, and the corresponding frequencies of $B^{10}Cl_3$ are derived. J.Jacobs

539.132

4541. CONFIGURATION INTERACTION IN $^1\Sigma_g^+$ STATE OF H_2 MOLECULE. A.Rahman.
Curr. Sci., Vol. 24, No. 11, 370-1 (Nov., 1955).
This is examined, for various internuclear distances, with one-electron wave functions arising in the solution of the H_2^+ problem. At equilibrium nuclear distance an energy of −2.3180 a.u. was obtained. J.Jacobs

539.132

4542. FREE RADICALS BY MASS SPECTROMETRY. IX. IONIZATION POTENTIALS OF CF_3 AND CCl_3 RADICALS AND BOND DISSOCIATION ENERGIES IN SOME DERIVATIVES. J.B.Farmer, I.H.S.Henderson, F.P.Lossing and D.G.H.Marsden.
J. chem. Phys., Vol. 24, No. 2, 348-52 (Feb., 1956).
For Pt VI, see Abstr. 11305 (1954). The vertical ionization potentials of CF_3 and CCl_3 radicals, as measured by elec-

tron impact, are 10.10 ± 0.05 and 8.78 ± 0.05 V respectively. From the appearance potentials of the CF_3^+ and CCl_3^+ ions from derivatives, the heats of formation of CF_3 and CCl_3 radicals were found to be −117 ± 2 kcal/mole and + 13.4 ± 3 kcal/mole respectively, assuming that no excess energy was included in the appearance potentials. From this data and other heats of formation, bond dissociation energies (in kcal/mole) have been evaluated. A.

539.132

4543. EVALUATION OF FORCE CONSTANTS FROM RAMAN EFFECT DATA: MOLECULES, RADICALS AND GROUPS OF PYRAMIDAL XY_3 TYPE. K.Venkateswarlu and S.Sundaram.
Proc. Phys. Soc. A, Vol. 69, Pt 2, 180-3 (Feb. 1, 1956).

The F-G matrix method introduced by Wilson (J. chem. Phys., Vol. 9, 76, 1941) is applied. G.I.W.Llewelyn

539.132

4544. ASYMMETRIC ROTOR. CONVERGENCE IN THE CONTINUED-FRACTION EXPANSION OF THE REDUCED ENERGIES. D.W.Posener.
J. chem. Phys., Vol. 24, No. 3, 546-7 (March, 1956).

Computation of the energy levels of the asymmetric rotor often involves the use of successive approximations which may converge slowly to the required result. The theory of convergence in the continued-fraction expansion of the reduced energies is here discussed and used to derive corrections which, where necessary, materially reduce the computational effort involved in obtaining solutions. A.

539.132

4545. IMPROVED VIBRATIONAL POTENTIAL FOR DIATOMIC MOLECULES. C.LeR.Beckel.
J. chem. Phys., Vol. 24, No. 3, 553-8 (March, 1956).

Previous methods used to obtain approximate vibrational potentials for diatomic molecules have led to potentials which are unsatisfactory at large internuclear separations. This paper presents a method by means of which more satisfactory potentials can be constructed. Poeschl-Teller functions are fitted to data near equilibrium, and to these functions are added perturbations of the form $T \cdot \tanh^{2a}\nu\alpha(r - r_0)$. The perturbations adjust the approximate potentials at large internuclear separations. This method is applied to several electronic states of H_2, D_2 and T_2. The resulting functions are good approximations to the true potentials even for relatively large internuclear separations. Very near dissociation the approximate potentials deviate from the true potentials in a consistent manner. A.

539.132

4546. SOME VIBRATION-ROTATION BANDS OF KETENE. W.F.Arendale and W.H.Fletcher.
J. chem. Phys., Vol. 24, No. 3, 581-7 (March, 1956).

Several vibration-rotation bands of ketene have been resolved with a grating spectrometer and the rotational constants obtained from the subsequent analysis. Parallel bands of CH_2CO and CD_2CO yield B_0 values of 0.3403 and 0.2952 cm^{-1}, respectively. Strong and apparently interactions prevent a satisfactory analysis of the perpendicular bands, but the methylene rocking and wagging bands appear to have origins at 978 cm^{-1} and 788 cm^{-1}, respectively. The low frequency perpendicular bands have been re-examined with a prism instrument, but with increased resolution. Analysis gives 588 cm^{-1} and 528 cm^{-1} for the band origins. A.

539.132

4547. CALCULATION OF POTENTIAL BARRIERS FOR ETHANE-LIKE SYMMETRIC TOPS. B.Bak.
J. chem. Phys., Vol. 24, No. 4, 918-19 (April, 1956).

Theoretical. Potential barriers for internal rotation in ethane and some silyl and halogenated ethanes are calculated reasonably well by assuming a particular spatial configuration during the rotation, and using the stretching and bending force constants. J.Hawgood

539.13

4548. NOTE ON THE CALCULATION OF ENERGY LEVELS IN MOLECULES WITH INTERNAL TORSION. J.D.Swalen.
J. chem. Phys., Vol. 24, No. 5, 1072-4 (May, 1956).

Approximate formulae are given for calculating the matrix elements of the angular momentum operator of a symmetric top undergoing hindered rotation on an asymmetric molecule. These can then be used to calculate the effect of torsion on overall rotation in microwave rotational spectra using the method of Wilson, Lin, and Lide. A

539.13

4549. VIBRATIONAL BAND INTENSITIES AND THE ELECTRICAL ANHARMONICITY OF THE NH GROUP. R.A.Russell and H.W.Thompson.
Proc. Roy. Soc. A, Vol. 234, 318-26 (Feb. 21, 1956).

The intensities of the first overtone vibration bands of the NH group in a series of complex molecules have been measured. The positions (cm^{-1}) of both ν_{NH} and $2\nu_{NH}$ for many compounds containing this group have also been measured in order to obtain the mechanical anharmonicity factors. The results of the present work on the overtone bands and of previous work on the fundamental vibration bands have been correlated and interpreted in terms of mechanical and electrical anharmonicity. By making reasonable approximations and regarding the vibrating system as a diatomic molecule, numerical functions have been derived for the variation of dipole moment with bond length in the different NH compounds, and the results reveal interesting correlations with ionic character. Significantly different conclusions are reached in certain cases according to the degree of approximation used in the calculation, and comparisons of different theoretical treatments have been made. A

539.132 : 535.343

4550. MICROWAVE SPECTRUM AND INTERNAL BARRIER OF ACETALDEHYDE. C.C.Lin and R.W.Kilb.
J. chem. Phys., Vol. 24, No. 3, 631 (March, 1956).

The observed nonrigid rotor spectra of CH_3CHO and CD_3CDO have been assigned by an extension of the theory of Abstr. 2938/1955; giving threefold barrier heights 1140 ± 40 and 1100 ± 70 cal, discrepancies found could be explained by sixfold barriers of 56 and 89 cal. J.Hawgood

539.132 : 535.343

MOLECULAR CONSTANTS OF CD_4. See Abstr. 3621

539.132 : 535.34

4551. EFFECT OF HYDROGEN BONDING ON THE DEFORMATION FREQUENCIES OF THE HYDROXYL GROUP IN ALCOHOLS. A.V.Stuart and G.B.B.M.Sutherland.
J. chem. Phys., Vol. 24, No. 3, 559-70 (March, 1956).

The effects of hydrogen bonding on the infrared spectra of aliphatic alcohols have been studied in the range 4000 to 350 cm^{-1}. Twenty-six alcohols were investigated of which 10 were primary, 7 were branched primary, 6 were secondary, and 3 were tertiary. Attention was concentrated on the region of the spectrum between 1500 cm^{-1} and 350 cm^{-1} where the deformation vibrations of the OH group occur. Spectra were obtained of the alcohols (a) in dilute solution in nonpolar solvents, (b) in the liquid state, and (c) in the vapour state, the degree of association being followed by observation of the well known effect of hydrogen bonding in the OH stretching vibration near 3.0 μ. Methanol, ethanol and hexanol-1 were also investigated after deuteration of the OH group. All the alcohols exhibited a broad diffuse association band with a maximum near 650 cm^{-1}. This has been assigned to the out-of-plane deformation vibration of the H atom in the COH group. All the alcohols also exhibited a broad association band which usually had 2 maxima near 1410 cm^{-1} and 1330 cm^{-1}. This band (whic

appears to have been missed by previous workers) is assigned to the in-plane deformation vibration of the H atom in the COH group. The corresponding monomeric band varies between 1200 cm^{-1} and 1330 cm^{-1} in undeuterated alcohols and between 870 cm^{-1} and 930 cm^{-1} in deuterated alcohols. There is in addition a very narrow association band which lies near 1100 cm^{-1} in primary and secondary alcohols and near 1165 cm^{-1} in tertiary alcohols. This is assigned to the effect of hydrogen bonding on the skeletal vibrations, which involve stretching of the CO bond. It appears that the effects of hydrogen bonding on the deformation motions of the OH group are quite complex and that steric effects, rotational isomerism and interaction with C–H deformation frequencies may all be involved to some extent. A.

539.132 : 539.133

4552. NORMAL VIBRATION FREQUENCIES OF CD_3F. STRUCTURE OF CH_3F AND CD_3F FROM INFRARED AND MICROWAVE SPECTRA. F A.Andersen, B.Bak and S.Brodersen.
J. chem. Phys., Vol. 24, No. 5, 989-92 (May, 1956).

The infrared absorption spectrum of CD_3F has been studied. Simultaneously, the infrared spectrum of CH_3F was reinvestigated. Fundamental vibration frequencies for CD_3F were found together with Coriolis coupling factors for the three degenerate vibrations in CH_3F and CD_3F. The fine-structure analysis gave reliable values for the large rotational constants of CD_3F and CH_3F. The structure of the methyl fluoride molecule is discussed. A.

539.132 : 539.133

4553. VIBRATION-ROTATION BANDS OF MONODEUTEROACETYLENE AND THE MOLECULAR DIMENSIONS. T.Overend and H.W.Thompson.
Proc. Roy. Soc. A, Vol. 234, 306-17 (Feb. 21, 1956).

Some vibration-rotation bands of monodeuteroacetylene have been measured with high resolution. Values have been derived for the coefficients α_i relating the rotational constants in different vibrational levels, as follows: $\alpha_2 = +0.00439$, $\alpha_3 = +0.00638$, $\alpha_4 = -0.0032_2$, $\alpha_5 = -0.0011$. Using the value $B_{00000} = 0.9910_5$ cm^{-1}, also determined from many bands, a new value, $B_e = 0.9948$, has been obtained leading to new estimates for the bond lengths $r_eCH = 1.058$ A, and $r_eC{\equiv}C = 1.205_0$. The l-doubling coefficient has been determined in two states, namely $q_{00010} = 0.0056$ and $q_{00003} = 0.0072$. In the ground state the results are in accordance with a centrifugal stretching coefficient $D = 0.7 \times 10^{-6}$, but in some higher levels a markedly different value is derived, which may, however, arise through the effects of Fermi resonance. A.

539.132 : 541.57

4554. STRETCHING FREQUENCIES AS A FUNCTION OF DISTANCES IN HYDROGEN BONDS. K.Nakamoto, M.Margoshes and R.E.Rundle.
J. Amer. Chem. Soc., Vol. 77, No. 24, 6480-91 (Dec.20, 1955).

Measurements of hydrogenic stretching frequencies of a number of hydrogen bonded compounds have been made in the crystalline state. For "straight" hydrogen bonds, approximately linear relations have been found between X–H...Y distances and the X–H stretching frequencies in the systems, O–H...O, O–H...N, N–H...F, N–H...O, N–H...Cl, N–H...N and O–H...F, while "bent" hydrogen bonds show large deviation from the regular sequence, always with higher frequencies. The effects of formal charge or coordination number have also been noticed. Based on these results, the crystal structures of several compounds and the nature of hydrogen bonding are discussed. A.

539.132

4555. THEORY OF THE ELECTRONIC SPECTRA AND STRUCTURE OF THE POLYACENES AND OF ALTERNANT HYDROCARBONS. R.Pariser.
J. chem. Phys., Vol. 24, No. 2, 250-68 (Feb., 1956).

See Abstr. 5636 (1953). The theory is further elucidated by listing specific formulae for the charge density, bond order, transition moment, and configuration interaction matrix elements. It is then applied to give a number of simple rules for alternant hydrocarbons. These refer to the energies of the singly excited states and the effects of configuration interaction, the degeneracy between certain singlet and triplet states, the prohibition of certain electronic transitions which would be allowed from a group theoretical point of view, and the charge density distribution of the ground and singly excited states. A mechanism is proposed to explain some of the anomalously rapid singlet-triplet radiationless transitions which are observed in connection with studies of the lower triplet states of complex molecules. Quantitative application of the theory is made to the spectra of the polyacenes, benzene through pentacene, and to the bond orders of naphthalene and anthracene, employing a high-speed digital computer. The calculated results are compared with experiment. Some previous assignments of electronic bands are confirmed, and some new assignments are suggested. The location of a number of excited states which have not, as yet, been observed is predicted. A.

539.132

4556. ELECTRONIC STRUCTURES OF NH, NH_2, AND NH_3. J.Higuchi.
J. chem. Phys., Vol. 24, No. 3, 535-45 (March, 1956).

LCAO MOs have been calculated for the ground states of NH, NH_2 and NH_3 at various bond angles, using the LCAO-SCF method. Interactions between all electrons have been considered, but the orthogonality relationship between the 1s orbitals of nitrogen and hydrogen has been assumed. The MOs and the orbital energies disclose strong parallelisms between the a_1 and the σ sets and between the b_2 and the e sets, but the s-p hybridization increases with the number of hydrogen atoms. The MOs have also been investigated by a unitary transformation to the localized symmetery orbitals, and the binding energies of orbitals have been compared with Walsh's MO energy diagram. The dipole moments evaluated without configuration interaction have been discussed in comparison with the contributions of lone-pair electrons. Lower electronic states have also been calculated using the same MOs. The results obtained are in relatively good agreement with observations, but the first excited state of NH_3 cannot conclusively be determined because of the disregard of the 3s orbital of nitrogen. A.

539.132

4557. LOWEST TRIPLET STATE OF ANTHRACENE. M.R.Padhye, S.P.McGlynn and M.Kasha.
J. chem. Phys., Vol. 24, No. 3, 588-94 (March, 1956).

A study has been made of the electronic transitions between the lowest triplet state of anthracene and its ground state. Low-temperature spectroscopic study of the phosphorescence revealed a sharp emission band with a 0, 0-frequency ($T \rightarrow S$) at 14927 cm^{-1} (EPA rigid glass solution at 77°K). A vibrational analysis in terms of known Raman frequencies indicates that the transition is of a $u \rightarrow g$ allowed type. The $T \leftarrow S$ absorption band was observed in anthracene with the 0, 0-frequency at 14850 cm^{-1} (solution at 293°K). The study of the phosphorescence spectra of seven different chlorinated anthracenes confirmed the assignment of the anthracene lowest triplet. This study re-establishes the earlier value obtained by Lewis and Kasha, and rejects the value deduced by Reid. A correlation of the above results for anthracene with calculations and observations on related polyacenes indicates that the lowest triplet of benzene is $^3B_{1u}$ (in D_{6h}) and for naphthalene, anthracene and naphthacene the lowest triplet is $^3B_{2u}$ (in D_{2h}). The perturbing singlets which mix with these triplets are obtained from previously derived rules for spin-orbital coupling in molecules. A.

539.132

4558. INFRARED SPECTRUM AND MOLECULAR CONSTANTS OF CARBON DIOXIDE. II. LEVELS $10^0 0$ AND $02^0 0$

$10^0 1$ AND $02^0 1$ COUPLED BY FERMI RESONANCE. K.Rossmann, W.L.France, K.Narahari Rao and H.H.Nielsen. J. chem. Phys., Vol. 24, No. 5, 1007-8 (May, 1956).

For Pt I see Abstr. 2282 (1956). Absorption bands of carbon dioxide involving the Fermi diads $10^0 0$, $02^0 0$ and $10^0 1$, $02^0 1$ have been investigated and molecular constants obtained. The variation in the centrifugal stretching constants which has been observed in the component levels is such that the average centrifugal stretching constant of the diad is very nearly the same as that of the vibrationless ground state of CO_2. A.

539.132

4559. MOLECULAR ASSOCIATION AND PROTON RESONANCE IN PROPIONIC ACID. B.N.Bhar and G.Lindström. J. chem. Phys., Vol. 23, No. 10, 1958-9 (Oct., 1955).

Curves are given for the change of chemical shift of the carboxyl protons of acetic and propionic acid as a function of dilution with H_2O. The changes of shift are explained as being due to a change of monomer/dimer ratio and the association correlation time and thence a change of the effective average chemical shift. D.H.Whiffen

539.132

4560. LINE-WIDTH TRANSITION OF THE PROTON MAGNETIC RESONANCE IN POLYMERS. A.Odajima, J.Sohma and M.Koike. J. chem. Phys., Vol. 23, No. 10, 1959-60 (Oct., 1955).

Proton magnetic resonance line widths from 20 to 140° C are measured for polystyrene, polymethylmethacrylate and polyvinylchloride, and the changes are interpreted in terms of the intramolecular motions. D.H.Whiffen

539.132

4561. PROTON HYPERFINE INTERACTIONS IN SEMIQUINONE IONS. R.Bersohn. J. chem. Phys., Vol. 24, No. 5, 1066-70 (May, 1956).

The proton hyperfine structure in a series of methylsubstituted semiquinone ions has been shown to arise in a general sense from configuration interaction. A crude calculation of the proton h.f.s to be expected in a hypothetical solution of $C_2H_4^+$ ions indicates that the $\sigma - \pi$ interaction is responsible for the h.f.s. of protons attached directly to an aromatic ring. The molecular orbital theory of hyperconjugation accounts for the detailed h.f.s. associated with the methyl protons. A.

539.132 : 539.152.2

4562. QUADRUPOLAR SPLITTING OF THE Al^{27} AND Be^9 MAGNETIC RESONANCES IN BERYL CRYSTALS. L.C.Brown and D.Williams. J. chem. Phys., Vol. 24, No. 4, 751-6 (April, 1956).

The quadrupolar hyperfine structure of the resonance peaks at 300°K have been examined. From the observed spectra, the following values were obtained for the nuclear spins I, the effective nuclear magnetic moments μ, the nuclear quadrupole coupling constants $eQ\varphi_{zz}$, and the electric field asymmetry parameters η:

$$Al^{27}: \; I = 5/2, \quad |\mu| = 3.6385 \pm 0.0003 \text{ n.m.},$$

$$|eQ\varphi_{zz}| = 3.093 \pm 0.015 \text{ Mc/s}, \quad \eta = 0.000 \pm 0.005.$$

$$Be^9: \; I = 3/2, \quad |\mu| = 1.1774 \pm 0.0002 \text{ n.m.},$$

$$|eQ\varphi_{zz}| = 0.504 \pm 0.004 \text{ Mc/s}, \quad \eta = 0.090 \pm 0.005.$$

A.

539.132

4563. AN APPROXIMATION METHOD OF WKB TYPE. I.Fényes. Acta phys. Hungar., Vol. 5, No. 2, 229-33 (1955). In German.

See also Abstr. 2955 (1955). On the basis of the work by Flügge and Marschall a method is proposed which does not start from the usual development in series. Indeed if the classical point mechanics is not used as zero approximation, the present approximation differs from the original solution by the WKB method. Combining this method with a variation process, the eigenfunctions of excited states can also be determined. J.Jacot

539.13

4564. MOLECULAR ORBITAL TREATMENT OF CONJUGATION IN VINYL CHLORIDE, WITH INCLUSION OF OVERLAP. J.H.Goldstein. J. chem. Phys., Vol. 24, No. 3, 507-9 (March, 1956).

Simple molecular orbital theory, with inclusion of all overlap effects, has been applied to the problem of conjugation in vinyl chloride. Using the value of −2.45 eV for the carbon-chlorine exchange integral, −10.64 eV for α_{Cl} as calculated from atomic ionization potentials, and other parameters assumed equal to the ethylene values, values of 9.99 eV and 0.063 are calculated for the ionization potential and chlorine Py-electron defect resulting from conjugation. These results are in good agreement with the experimental values, 9.95 eV and 0.06, respectively. A convenient distribution matrix treatment is described and some of the effects of neglect of overl are discussed.

539.13

4565. QUANTUM-MECHANICAL STUDY OF THE INDUCTIVE EFFECT. J.M.Cahill and C.R.Mueller. J. chem. Phys., Vol. 24, No. 3, 513-17 (March, 1956).

The inductive effect of a carbonyl group on an adjacent carbon-carbon bond is investigated by means of the semi-localized orbital method. The electronic structure of the isolated bonds is calculated and then the result of their interaction is investigated. The inductive effect is found to be of sizable magnitude and to originate largely from the field of the oxygen atom. Propagation of the inductive effect by means of successive distortion of valence orbitals, through the bond appears to be less important.

539.13

4566. THE ELECTROSTATIC CALCULATION OF MOLECULAR ENERGIES. IV. OPTIMUM PAIRED-ELECTRON ORBITALS AND THE ELECTROSTATIC METHOD. A.C.Hurley. Proc. Roy. Soc. A, Vol. 235, 224-34 (April 24, 1956).

For Pt III, see Abstr. 1091 (1955). Equations which determine the optimum form of paired-electron orbitals are derived. It is shown that for large nuclear separations these equations become the Hartree-Fock equations for appropriate valence states of the separated atoms. An electrostatic interpretation of chemical bonding is developed using optimum paired-electron orbital functions. For these wave-functions this simple procedure yields results identical with those obtained by the conventional method of calculation based on the Hamiltonian integral. Numerical computations by the electrostatic method are also discussed.

539.13

4567. MOLECULAR ORBITAL WAVE FUNCTIONS FOR METHANE AND SILANE. C.Carter. Proc. Roy. Soc. A, Vol. 235, 321-34 (May 8, 1956).

Molecular orbital wave-functions for methane and silane are set up as harmonic expansions about the central nucleus origin. This method avoids the many-centred integrals of the l.c.a.o. theory. Energies, bond lengths and force constants ar obtained quite accurately using only the first term in each expansion. In this case the radial wave-functions may be calculated by the Hartree s.c.f. method as for atoms. Scale-factor methods are developed to obtain the bond length and force constant from the s.c.f. wave-functions calculated for a single internuclear distance, and to determine the approximate effe of exchange terms. It is shown that the higher terms in the expansion of the m.o.'s are important in the calculation of some molecular properties, particularly angular momentum and di magnetic susceptibility.

539.132

4568. A MOLECULAR ORBITAL TREATMENT OF DIBORANE AS A FOUR-CENTRE, FOUR-ELECTRON PROBLEM. W.C.Hamilton.
Proc. Roy. Soc. A, Vol. 235, 395-407 (May 8, 1956).

The Roothaan self-consistent field equations in their linear combination of atomic orbitals form have been solved for a system composed of four electrons in the field of a framework of two asymmetric boron cores of net charge + 1 each and two protons in the "bridge" positions as in diborane. Exact values for all one and two-centre integrals were used, and approximations were made for three- and four-centre integrals. The molecular orbitals of lowest energy are the completely symmetric orbital and the π-orbital with a nodal plane normal to the line between the protons. In terms of the molecular-orbital coefficients, there is a small residual net negative charge on the hydrogens, i.e. the bridge hydrogens have a hydridic character. In terms of configurational expansions, a localized three-centre bond description of the molecule is very close to the actual configuration and is somewhat better than a description as a resonance hybrid between either ordinary covalent valence bond structures or localized two-centre molecular orbital structures. A.

539.132

4569. VALENCE FORCES IN THREE- AND FOUR-MEMBERED RINGS. H.H.Jaffe.
Z. Elektrochem., Vol. 59, No. 9, 825-9 (1955). In German.

See Abstr. 7623 (1954). A comparison of MO and VB descriptions of bonds which may be considered as small three- or four-membered rings. The many centre forces which occur present difficulties in the VB method; whereas both Lennard-Jones' equivalent orbitals or Coulson and Moffitt's non-localized orbitals are adequate. J.Jacobs

539.132 : 518.5

4570. THE APPLICATION OF ELECTRONIC DIGITAL COMPUTERS TO MOLECULAR ORBITAL PROBLEMS. I. A NEW APPROXIMATION FOR HETERO-ATOM SYSTEMS. I.O.Pritchard and F.H.Sumner.
Proc. Roy. Soc. A, Vol. 235, 136-43 (April 10, 1956).

The programmes described in Pt.I (Abstr. 435/1955) are extended to deal with problems including overlap integrals. These programmes are used to investigate a new molecular orbital approximation which is generally applicable to systems containing hetero-atoms, whether these atoms contribute none, one or two electrons to the delocalized system. A.

539.132 : 541.57

4571. HYDROGEN BOND SYSTEMS: TEMPERATURE DEPENDENCE OF OH FREQUENCY SHIFTS AND OH BAND INTENSITIES. J.N.Finch and E.R.Lippincott.
J. chem. Phys., Vol. 24, No. 4, 908 (April, 1956).

Reports measurements on these properties of alcohols and phenols in the range 2500-4000 cm^{-1} and $-80^{\circ}C$ to $25^{\circ}C$, showing that the frequency of the OH band decreases and its intensity increases with rise of temperature. J.Hawgood

539.133

4572. DETERMINATION OF MOLECULAR STRUCTURES FROM ROTATIONAL SPECTRA MEASUREMENTS. R.E.Turner and J.A.Howe.
J. chem. Phys., Vol. 24, No. 4, 924-5 (April, 1956).

Outlines a computation scheme, suited to digital computers, for determining structure from rotational constants of isotopically substituted asymmetric molecules, giving results on ethylene oxide as an illustration. J.Hawgood

539.133 : 535.343

4573. MICROWAVE SPECTRUM AND DIPOLE MOMENT OF CYCLOPENTADIENE. V.W.Laurie.
J. chem. Phys., Vol. 24, No. 3, 635-6 (March, 1956).

Fifteen rotational transitions in the regions 19.5 - 24 and 29-30 kMc/s have been measured and assigned by a rigid asymmetric rotor model. The rotational constants agree reasonably with those calculated from the model of Schomacher and Pauling (1939). The dipole moment is calculated from the Stark effect of the 1-2 transitions to be 0.416 ± 0.010 D.

J.Hawgood

539.133 : 538.224

4574. ROTATIONAL MAGNETIC MOMENT AND DIAMAGNETIC SUSCEPTIBILITY OF METHANE. W.Weltner, Jr.
J. chem. Phys., Vol. 24, No. 4, 918 (April, 1956).

The rotational magnetic moment of CH_4 is deduced from microwave Zeeman measurements on $CH_3{-}C{\equiv}C{-}D$, indicating that the usually neglected paramagnetic contribution to the susceptibility of CH_4 is about 40% of the magnitude of the diamagnetic term, and that simple MO and VB calculations give good values of $\langle r^2 \rangle_{Av}$. J.Hawgood

539.133

4575. SPIN VALENCE AND REAL MOLECULE. K.Artmann.
Z. Phys., Vol. 144, No. 5, 549-71 (1956). In German.

It is shown that spin valence, in Heitler–Rumer approximation, gives the same dependence of molecular energy on angles between outer atoms as does the approximation of localized valences. This holds for H_2S, PH_3, and is now assumed true also for molecules with a central C atom. The variations from the equilibrium values of the tetrahedron angles for CH_3Cl, CH_2Cl_2, $CHCl_3$, and cyclic paraffins, are therefore determined using spin valence. Results are in good agreement with Penney's and Coulson and Moffitt's theory as well as with experimental values, provided their effects and polar properties are taken into account. J.Jacobs

539.133 : 535.343

MOLECULAR STRUCTURE OF $(CH_3)_3$ SiBr. See Abstr. 3631

ATOMS. NUCLEUS. ISOTOPES 539.15

539.152.1

4576. THE SURFACE ENERGY OF AN EXCITED ATOMIC NUCLEUS. G.Marx and G.Szamosi.
Acta phys. Hungar., Vol. 5, No. 2, 189-98 (1955). In German. German.

The temperature dependence of the nuclear surface energy is calculated using the method of Born and Courant to define a surface potential. As the excitation energy increases this surface potential is found to decrease. J.Hughes

539.152.1

4577. ON THE DILATION OF THE S-SHELL OF O^{16}. B.Jancovici.
C.R. Acad. Sci. (Paris), Vol. 242, No. 7, 883-4 (Feb. 13, 1956). In French.

Previous calculations (Abstr. 6391/1955) are corrected for the motion of the centre of mass and give, for parameters fitted to He^4, too little binding, and too large a radius. Alternative calculations, using the s- and p-shell radii as parameters in a variational calculation, lead to a radius for the s-shell much larger than the observed radius of He^4. This suggests large deformation of the internal shells by the peripheral nucleons. P.T.Matthews

539.152.1

4578. ELECTRIC MONOPOLE TRANSITIONS IN C^{12} AND O^{16}. J.P.Elliott.
Phys. Rev., Vol. 101, No. 3, 1212 (Feb. 1, 1956).

The discrepancy, found by Schiff (Abstr. 7278/1955), for these transitions is removed by taking a shell model configurational assignment for the excited 0^+ state consistent with the results of intermediate coupling. P.T.Matthews

539.152.1

4579. THEORY OF THE 0^+ STATES OF O^{16}. R.A.Ferrell and W.M.Visscher.
Phys. Rev., Vol. 102, No. 2, 450-2 (April 15, 1956).

The usual shell-model interpretation of the 6.06 MeV 0^+ level of O^{16} as two-nucleon excitation is replaced by one-nucleon excitation. The large excitation energy for an individual nucleon is greatly reduced for special linear combinations of the excited shell-model configurations, because of a resonance effect arising from the degeneracy and from the large off-diagonal matrix elements. The state of collective compressional-dilational oscillation of the nucleus is shown to be a particularly favourable such linear combination, and the results of an explicit calculation indicate that the resonance effect is strong enough to account for the 6.06 MeV level. It is also proposed to interpret the 6.91 MeV 2^+ level as a superposition of one-nucleon excited configurations corresponding to spheroidal deformation. A.

539.152.1

4580. SURFACE OSCILLATIONS IN EVEN-EVEN NUCLEI. L.Wilets and M.Jean.
Phys. Rev., Vol. 102, No. 3, 788-96 (May 1, 1956).

Surface oscillations in nuclei with deformation potentials independent of the shape parameter γ are discussed, and are found to describe qualitatively the regularities in even-even nuclei of the type discussed by Scharff–Goldhaber and Weneser. A.

539.152.1

4581. THE BRUECKNER THEORY OF NUCLEAR STRUCTURE. R.J.Eden.
Proc. Roy. Soc. A, Vol. 235, 408-18 (May 8, 1956).

The object of the Brueckner theory is to calculate the properties of atomic nuclei from a knowledge of the forces which act between nucleons in free space. The method involves constructing a nuclear model having the same energy as the nucleus, and it also gives a relation between the nuclear model and the actual nucleus which can be used to investigate detailed aspects of the nucleus in circumstances where the model is insufficient. Previous papers on the Brueckner theory have used a formalism applicable only to an infinite medium of nuclear matter and this has involved some inconsistencies. The present paper establishes the theory in a form which applies to a nucleus of finite size and therefore provides a basis for calculating from first principles the properties of an actual nucleus. The nuclear model on which the method is based is closely related to the nuclear shell model and is determined by a set of coupled self-consistent equations which taken into account the strong short-range character of nuclear forces. These self-consistent equations have also been derived by H.A.Bethe who describes methods of solving them in a paper to be published. The present paper concentrates on the derivation and meaning of the equations for the model, on their relation to a self-consistent variational procedure, on the relation between the model and the nucleus and on discussing correction terms neglected in the construction of the model. The justification of the theory depends primarily on the operation of the exclusion principle between nucleons, but it also involves a physical assumption related to the absence of clustering in the nucleus. A.

539.152.1 : 530.145

4582. SELF-CONSISTENT FIELD CALCULATION OF THE NUCLEAR BOUNDARY DIFFUSENESS. J.D.Talman.
Phys. Rev., Vol. 102, No. 2, 455-7 (April 15, 1956).

A lower limit to the nuclear boundary diffuseness parameter σ, defined by fitting to the density a function of the form $\rho = \rho_o\{1 + \exp[(r - a)/\sigma]\}^{-1}$, has been estimated by carrying out the first stage of a self-consistent field calculation. The result is in agreement with present experiments, but it is expected that succeeding calculations will yield an appreciably larger result. A.

539.152.2

4583. ON THE JENSEN–MAYER CORRECTION TO THE MAGNETIC MOMENT OF K^{40} IN INTERMEDIATE COUPLING E.Maréchal.
C.R. Acad. Sci. (Paris), Vol. 242, No. 7, 881-3 (Feb. 13, 1956). In French.

539.152.2

4584. ELECTRIC MULTIPOLE MOMENTS IN j-j COUPLIN(R.D.Lawson.
Phys. Rev., Vol. 100, No. 3, 845-6 (Nov. 1, 1955).

It is possible to derive a simple expression for the electric quadrupole moment of any I-state arising in j-j coupling, from the proton configuration $(l_j)^n$, without explicitly setting up the wave-function in question. If the given I-state occurs more than once, only the sum of the quadrupole moments is obtainable by this method. In principle, it is possible to generalize the theory to higher electric multipole moments. A

539.152.:

4585. NUCLEAR MOMENTS IN jj-COUPLING. S.Sengupta
Phys. Rev., Vol. 100, No. 3, 939-40 (Nov. 1, 1955).

Lawson's method (preceding abstract) for calculating nuclear electric quadrupole moments is extended to equivalen configurations containing both neutrons and protons.
P.T.Matthew

539.152.2 : 539.1

4586. CONCEPT OF TEMPERATURE AND THE OVER HAUSER NUCLEAR POLARIZATION EFFECT. C.P.Slichter
Phys. Rev., Vol. 99, No. 6, 1822-3 (Sept. 15, 1955).

The polarization of nuclei by the Overhauser method is examined for the case of metals. It is shown that the concept of temperature is valid for the conduction electrons if they are viewed from a coordinate system rotating at the electron Larmor frequency ω. Relative to this system, the nuclei precess at nearly $-\omega$, a result equivalent to an enormous nuclear magnetic coupling. The Overhauser result then follow immediately. A

539.152.2 : 681.14

4587. SPIN ECHO SERIAL STORAGE MEMORY. A.G.Anderson, R.L.Garwin, E.L. Hahn, J.W.Horton, G.L.Tucker and R.M.Walker.
J. appl. Phys., Vol. 26, No. 11, 1324-39 (Nov., 1955); Erratum, Vol. 27, No. 2, 196 (Feb., 1956).

By utilizing the method of pulsed nuclear magnetic reso ance, radio frequency energy in the form of pulses can be sto serially in a sample of nuclear spins and recalled at an arbitrary later time within the memory or relaxation time of the spin sample. Weak pulses of radio-frequency energy conditio the nuclear spins to start precessing in phase. After they be come completely out of phase, a strong recollection pulse brings about a phase reversal of precession and produces a series of spin echoes in a sequence corresponding to direct reverse order of input pulses. The echo amplitudes in such series are given as a function of the number and strength of the input pulses and the conditions for maximum storage cap city in a spin ensemble are determined. The maximum speci fic storage capacity in liquids is expressed in terms of the thermal noise of the detecting apparatus, the effect of self-diffusion of the molecules, and the relaxation times. The or gin of undesired spin echoes arising from the interaction of input pulses is discussed, and means for eliminating these echoes by frequency and magnetic field modulation are discussed and applied. Extensive use is made of a magnetic fie modulation technique to destroy undesired echoes, and to pe mit novel types of recall of serially stored groups of pulses Whereas Fernbach and Proctor (Abstr. 3977/1955) have demonstrated multiple pulse storage under conditions which reproduce the input pulse shape, the present investigation i concerned with the storage of a maximum number of pulses whose shape is ideally determined by the nuclear spin band width. In practice, the order of 1000 r.f. pulses can be stor

and recalled by this method in a proton sample several cm^3 in volume within a memory time of 10,to 50 milliseconds. Large specific storage capacities expected for existing long relaxation time liquids are not realized because of excessive self-diffusion. A.

539.153

4588. LAMB SHIFT OF THE 1^2S GROUND STATE OF DEUTERIUM. G.Herzberg.
Proc. Roy. Soc. A, Vol. 234, 516-28 (March 6, 1956).

According to modern quantum electrodynamics, the 1S level (ground state) of hydrogen and deuterium is predicted to lie 0.272_6 cm^{-1} above the energy given by the Dirac theory. In order to obtain an experimental value for this Lamb shift, the absolute wavelength of the L_α line of deuterium has been determined by means of a 3 m vacuum grating spectrograph in fifth order. Lines of the series $6^1S_0 - n^1P_1$ and $6^1S_0 - n^3P_1$ of Hg^{198} observed in the same order were used as standards. The wavelengths of these standards were obtained to ±0.0002 A by the combination principle from lines in the visible and near ultraviolet regions, some of which were newly measured. Both the far ultraviolet Hg lines and L_α of deuterium were simultaneously recorded on the plate in absorption. In this way, from six independent plates the wavelength of the L_α line of deuterium was found to be 1215.3378 ± 0.0003 A. This value refers to an unresolved doublet. If the relative intensity of the two doublet components (2 : 1) and the temperature of the absorbing column (80° K) is taken into account and the result compared with the Dirac value of L_α, a shift of the 1^2S level of $0.26_2 \pm 0.03_8$ cm^{-1} is obtained. The agreement with the predicted value is very satisfactory. A.

539.153

4589. MEASUREMENTS OF LIFETIMES OF EXCITED STATES OF HELIUM ATOMS. S.Heron, R.W.P.McWhirter and E.H.Rhoderick.
Proc. Roy. Soc. A, Vol. 234, 565-83 (March 6, 1956).

A new method of measuring lifetimes of excited states of atoms has been devised and applied to helium. A short pulse (10^{-8} sec duration and 10 kc/s repetition rate) of low-voltage electrons causes atoms of a gas to be raised to excited states. The subsequent decay to lower states is observed by intercepting the emitted photons with a photomultiplier, those belonging to the desired transition being selected by means of a filter. By recording delayed coincidences between the photomultiplier pulses and the electron pulses the rate of decay of the excited states can be measured. If certain conditions are satisfied, the decay is exponential with a decay constant equal to the reciprocal of the natural lifetime of the excited state. The mean lifetimes of the 4^3S, 3^3P, 4^3P and 3^3D terms of helium are found to be 6.75 ± 0.10, 11.5 ± 0.5, 15.3 ± 0.2 and 1.0 ± 0.5 respectively, in units of 10^{-8} sec. These values agree well with the theoretical calculations of Bates and Damgaard. The apparent lifetime of the 3^1P level is modified by the imprisonment of resonance radiation in a manner in qualitative agreement with Holstein's theory. The 2^1S-3^1P transition probability is found to be $(1.35 \pm 0.02) \times 10^7$ sec^{-1} A.

539.153 : 537.122

4590. MAGNETIC MOMENT OF THE ELECTRON. P.Kusch.
Science, Vol. 123, 207-11 (Feb. 10, 1956).

A detailed review of the application of the molecular-beam magnetic resonance method in the determination of the electron spin g factor. It is concluded that the experimental results confirm the validity of the Karplus–Kroll quantum electrodynamical calculations to the order α, and offer strong support for the theory to the order α^2. R.A.Newing

539.153.4

4591. NUMERICAL DETERMINATION OF THE GROUND STATE OF THE MESONIC ATOM. M.Suffczyński.
Acta phys. Polon., Vol. 14, No. 3, 257-61 (1955).

A simple numerical process is illustrated by a calculation in which an exponential potential is employed. G.E.Brown

539.153.4

4592. THE DETERMINATION OF THE RADIAL AND AZIMUTHAL PARTS OF THE ZERO-POINT ENERGY IN THE STATISTICAL MODEL OF THE ATOM. I.Fényes.
Acta phys. Hungar., Vol. 5, No. 2, 235-39 (1955). In German.

See also Abstr. 2955 (1955). These can be computed without further assumptions and are found to be in the ratio 2 : 1, in agreement with Gombas' conjecture. For the detailed calculation the author's earlier results were used, see Abstr.7200 (1949). J.Jacobs

539.153.4

4593. ON A DERIVATION OF THE SLATER SEMI-EMPIRICAL ATOMIC EIGENFUNCTIONS. P.Gombás and P.Szépfalusy.
Acta phys. Hungar., Vol. 5, No. 2, 259-63 (1955). In German.

A potential is added to that from the self-consistent field and adjusted to guarantee orthogonality of the radial functions of the low-lying atomic electrons. Solution of the Schrödinger equation gives wave functions similar to Slater's. G.E.Brown

539.153.4

4594. APPROXIMATE WAVE FUNCTIONS FOR SOME ATOMS OF THE FIRST LONG PERIOD. D.R.Hartree.
J. Opt. Soc. Amer., Vol. 46, No. 5, 350-3 (May, 1956).

Preliminary calculations, with exchange, of wave-functions for some atoms of the first long period have been made. The results for Mn show that the (3d)-wave-function of the $(3d)^5(4s)^2$ ^6S state of neutral Mn differs little from that of the $(3d)^5$ ^6S state of Mn^{+2}, whereas it differs considerably from that of the $(3d)^7$ ^4F state. Similar results are to be expected for other atoms. The (3d) wave-functions of Ti^+, Mn^+, and Cu^+ show a close approach to geometrical similarity; so also do those of V^{+2} and Mn^{+2}. For the singly-ionized atoms Ca^+ to Cu^+, the screening number for the (3d) wave-function at first decreases with increasing atomic number; a physical reason is given for this behaviour. The relation of these results, and others interpolated from them, to the results of Catálan, Rohrlich, and Shenstone on the "horizontal analysis" of the low terms of the spectra of atoms of the first long period is shown. A.

539.153.4

4595. NATURAL ORBITALS IN THE QUANTUM THEORY OF TWO-ELECTRON SYSTEMS. P.-O. Löwdin and H.Shull.
Phys. Rev., Vol. 101, No. 6, 1730-9 (March 15, 1956).

The wave functions for the singlet and triplet states of a two-electron system in a given nuclear framework are investigated as superpositions of configurations and are shown to be transformationally equivalent to quadratic forms having certain ranks and signatures. By introducing the 'natural orbitals' diagonalizing the generalized first-order density matrix, the total wave functions may also be brought to principal form. If the basis contains M one-electron functions, the singlet and triplet wave functions contain respectively $M(M+1)/2$ and $M(M-1)/2$ configurations, but the transformation to natural orbitals reduces the number of terms to M and $[M/2]$ respectively. The natural expansion having the best convergence is also characterized by another important extremum property. The approximate wave function of rank r having the smallest quadratic deviation from the exact eigenfunction is obtained by interrupting the natural expansion of the eigenfunction after r terms and renormalizing the result. For the singlet state, the wave function of rank two and signature zero has a special importance as giving a simple extension of the visual one-electron picture to include a large part of the correlation effects. The theory is illustrated by some results on helium obtained by using radial configuration interaction. A.

539.155.2

4596. SEPARATION OF $^{14}C^{16}O$ AND $^{12}C^{18}O$ BY THERMAL DIFFUSION. A.E.de Vries, A.Haring and W.Slots.

Physica, Vol. 22, No. 3, 247-8 (March, 1956).

Other workers have investigated the separation, by thermal diffusion, of molecules of the same mass but different chemical composition, and also for molecules of the same chemical composition but with different symmetry and moments of inertia, i.e. $O^{16}C^{13}O^{16}$ and $O^{16}C^{12}O^{17}$This work is an investigation of the properties of two molecules of the same mass and symmetry but with different moments of inertia. The separation between $C^{14}O^{16}$, $C^{13}O^{18}$ and $C^{12}O^{16}$ was measured in a thermal diffusion column (5 metres long). Samples from the top and bottom were compared; the $C^{13}O^{18}$ being measured by mass spectrometer and the $C^{14}O^{16}$ by a β counting method. The thermal-diffusion factor between $C^{14}O^{16}$ and $C^{12}O^{16}$ was about 15 ± 3% larger than for the $C^{12}O^{18}$–$C^{12}O^{16}$ mixture. H.C.Cole

539.155.2 : 533.15

PREPARATION IN PURITY OF THE ISOTOPE Xe^{136}
See Abstr. 3543

539.155.2 : 537.36

4597. CONCENTRATING Li ISOTOPES BY ELECTROMIGRATION IN THE MELT PHASE. M.Chemla.
C.R. Acad. Sci. (Paris), Vol. 242, No. 11, 1450-2 (March 12, 1956). In French.

See Abstr. 2331 (1956). $LiNO_3$ deposited on asbestos paper impregnated with melted $NaNO_3$–KNO_3 mixture was subjected to a d.c. of 620 V and 150 mA at 300° C. After 2 hours the distance of migration was 20 cm, and the Li^7/Li^6 ratio was, in front of the spot, 5.0 compared with 11.5 in the natural element. The ionic mobilities of the two isotopes differ by ~3%. F.Lachman

RADIOACTIVITY. α-, β- AND γ-RAYS 539.16

539.16.08

4598. ON THE APPLICATION OF THE ALTERNATING-LIGHT METHOD IN NUCLEAR PHYSICS. R.Duhme.
Z. Phys., Vol. 144, No. 1-3, 132-8 (1956). In German.

The principle of the method is to modulate the incoming signal (e.g. the intensity of a beam) so that the alternating current response from the registering apparatus (e.g. an ionization chamber) can be amplified by conventional a.c. methods. A discussion of the limit on the attainable sensitivity (e.g. due to the shot-effect in the amplifier) is given. The practicability of the method is demonstrated in measurements of the intensity of a neutron beam where the modulation was provided by a shutter of three paraffin blocks rotating at 1500 r.p.m. W.J.Swiatecki

539.16.08 : 537.542

4599. IMPROVEMENT OF COINCIDENCE TECHNIQUES APPLIED TO THE [ABSOLUTE] STANDARDIZATION OF RADIOACTIVE INTENSITY (FOR SOURCES OF 5-50 μc). S.Vuccino.
J. Phys. Radium, Vol. 17, No. 1, 57-9 (Jan., 1956). In French.

An analysis of the main causes of error and of the factors limiting accuracy. A suitable set-up with a resolving time of 3×10^{-7} sec is described, and results of measurements on sources of Co^{60}, Sc^{46}, Na^{24}, Na^{22} and Au^{198} are given. A.O.Stanesby

539.163

4600. DECAY OF Ni^{66}. N.R.Johnson, R.K.Sheline and R.Wolfgang.
Phys. Rev., Vol. 102, No. 3, 831-3 (May 1, 1956).

A study of the beta and gamma spectra of the nuclide Ni^{66} has been made. This decays by a single beta-ray of 0.20 ± 0.03 MeV, with no associated gammas, to the ground state of Cu^{66}. Both the log(ft) value and the shape of the Kurie plot indicate that this transition is allowed, thereby confirming the earlier spin and parity assignments of the ground state of Cu^{66}, and the 1.03 MeV excited level in Zn^{66}. A.

539.163

4601. L/K-CAPTURE RATIOS, MEAN L-FLUORESCENCE YIELDS, AND TRANSITION ENERGIES IN ORBITAL ELECTRON-CAPTURE. B.L.Robinson and R.W.Fink.
Rev. mod. Phys., Vol. 27, No. 4(I), 424-30 (Oct., 1955).

A summary and analysis of existing experimental data (to May, 1955) on nuclides with relatively simple and well established decay schemes. Various applications of theory are given e.g. computation of capture ratios using known transition energies and decay schemes (28 nuclides). Agreement between theory and experiment is good in the few cases for which sufficiently complete experimental data exists. J.J.Wilkins

539.163

4602. SARGENT DIAGRAM AND COMPARATIVE HALF-LIVES FOR K-ELECTRON CAPTURE TRANSITIONS OF ODD NUCLIDES (WITH $Z \leq 60$). L.S.Cheng.
Rev. mod. Phys., Vol. 28, No. 1, 45-7 (Jan., 1956).

Modified Sargent diagram of K-electron capture transitions of odd nuclides with $Z \leq 60$ shows an allowed transition band with superallowed transitions well above the first-forbidden transitions below it. Correspondingly the histogram of log ft values of these transitions shows a peak in the range of 5 to 6. A.

539.163.1

4603. THE HALF-LIFE OF THE FIRST EXCITED STATE OF ^{111}Cd. L.H.T.Rietjens, H.J.van den Bold and A.Heyligers.
Physica, Vol. 21, No. 11, 899-900 (Nov., 1955).

The half-life of the 247 keV isomer of Cd^{111} was found to be $(8.5 \pm 0.2) \times 10^{-8}$ sec, using scintillation counters and delayed coincidence techniques. J.Hughes

539.163.2

4604. DECAY OF Ca^{49} AND Sc^{49}. D.W.Martin, J.M.Cork and S.B.Burson.
Phys. Rev., Vol. 102, No. 2, 457-8 (April 15, 1956).

Ca^{49} has been found to decay with a half-life of 8.9 ± 0.2 minutes. It emits two principal beta components of energies 2.12 ± 0.10 and about 1.0 MeV in coincidence respectively, with gamma-rays of 3.07 ± 0.05 and 4.04 ± 0.06 MeV. The intensity ratio of these two branches is 8.5 : 1. The intensity of a possible ground-state beta branch is less than 1%, and that of a possible 0.98 MeV gamma transition between the 3.07 and 4.04 MeV levels is less than 3%. These data indicate that these excited states are respectively the single-particle $p_{3/2}$ and $f_{7/2}$ levels available for excitation of the twenty-first proton in Sc^{49} Sc^{49} is found to emit in turn a single beta component of energy 1.80 ± 0.10 MeV. A.

539.163.2

4605. DECAY OF Rn^{220} AND Rn^{222}. L.Madansky and F.Rasetti.
Phys. Rev., Vol. 102, No. 2, 464-5 (April 15, 1956).

A gamma ray of energy 510 ± 2 keV and approximate intensity 7×10^{-4} quanta per decay is emitted in the alpha decay of Rn^{222}. A gamma ray of energy 542 ± 2 keV and approximate intensity 2.5×10^{-4} quanta per decay is emitted in the alpha decay of Rn^{220}. The intensities are considered accurate only to within a factor of two. A.

539.163.2

4606. DECAY OF In^{114m} AND In^{114}. L.Grodzins and H.Motz
Phys. Rev., Vol. 102, No. 3, 761-5 (May 1, 1956).

Scintillation counter experiments have been performed o the 72 sec activity of In^{114} produced by (p, n) and (d, 2n) cyclotron bombardment of enriched Cd^{114} and on the 49 day activity of In^{114m} produced by neutron activation. The well-known

556-722 keV cascade radiation of Cd^{114} is shown to be excited by a K-capture transition from the 49 day isomeric level. The weak 1300 keV gamma-ray previously assigned to Cd^{114} is shown to come from the first excited state of Sn^{114} and is in coincidence with a low-energy beta spectrum having an end point of 675 ± 40 keV. No gamma-rays in Cd^{114} other than the 556 and 722 keV lines have been observed from the decay of In^{114m} or In^{114}. A 1.9% K-capture branch from In^{114} to the ground state of Cd^{114} has been found. A positron branch of ~ 0.004% between these two states is shown to have an end point of 400 ± 25 keV. A.

539.163.2

4607. DECAY OF IONIUM (Th^{230}). E.Booth, L.Madansky and F.Rasetti.
Phys. Rev., Vol. 102, No. 3, 800-1 (May 1, 1956)

Gamma-ray coincidence studies of the decay of ionium yield the total conversion coefficient of the 68 keV gamma-ray as $\alpha = 46 \pm 5$, and a value of $f = 0.52 \pm 0.05$ for the fluorescent yield from the L shell of Ra^{226}. The mean lifetime of the 68 keV state of Ra^{226} was found to be $T_{1/e} \leq 10^{-9}$ sec. A.

539.163.2

4608. DECAY SCHEME OF Br^{82}. R.C.Waddell and E.N.Jensen.
Phys. Rev., Vol. 102, No. 3, 816-23 (May 1, 1956).

The radiations from Br^{82} were studied using an intermediate-image coincidence spectrometer, gamma-gamma coincidence scintillation spectrometer, and gamma-gamma directional correlation equipment. One allowed beta-ray group and eight gamma-rays were observed. An energy level diagram is proposed. Determinations of the energies, relative intensities, and internal conversion coefficients were made. Five directional correlation measurements were performed between various gamma-ray combinations. Unambiguous assignments for the spins and parities of four of the first five excited levels are made, while the assignment for the remaining level is restricted to two possible values. Multipole mixing ratios were measured for three of the transitions. A possible interpretation of the excited states, in terms of vibrational levels, is proposed. A.

539.165

4609. INVESTIGATIONS ON THE β-DECAY OF $^{208}_{81}Tl$(ThC''). F.Demichelis, R.A.Ricci and G.Trivero.
Nuovo Cimento (Ser. 10), Vol. 3, No. 2, 377-89 (Feb., 1956).

The β-spectrum of $_{81}Tl^{208}$ has been investigated by the following experimental methods: the absorption method, the β-γ coincidence technique and the grey wedge oscillographic method. The experimental results show the existence of a new β-transition with maximum energy 2.37 MeV from the ground state of $_{81}Tl^{208}$ to the first excited state of $_{82}Pb^{208}$. Its relative intensity (branching ratio) is ≅ 1.5% of the disintegrations of $_{81}Tl^{208}$. The 2.37 MeV β-transition is followed by a 2.62 MeV γ-ray. Moreover the already known β-transition of maximum energy 1.79 MeV was found and β-transitions of maximum energy 1.28 MeV;1.52 MeV were detected which were thought probable by other authors, but hitherto not experimentally verified. At the same time, the existence of a β-branch of maximum energy (2.15 ± 0.11) MeV was noticed; it must be assigned to $_{83}Bi^{212}$ (value already known: 2.25 MeV) which is present with $_{81}Tl^{208}$ in the radioactive source $_{90}Rd^{228}Th$ in equilibrium with its decay products). In conclusion the degree of forbiddenness of the higher energy components (2.37 MeV; 2.25 MeV; 1.79 MeV) is discussed. A.

539.165

4610. INTERNAL PAIR CREATION IN BETA DECAY. K.Huang.
Phys. Rev., Vol. 102, No. 2, 422-6 (April 15, 1956).

A physical picture is presented for internal pair creation in beta decay, and the ratio of the total number of positrons to the total number of electrons emitted is calculated for the transition $P^{32} \rightarrow S^{32}$. The result is in agreement with the experiment of Greenberg and Deutsch. A.

539.165

4611. ABSORPTION COEFFICIENTS FOR β-RAY-EMITTING RADIO ISOTOPES. II. FUNDAMENTALS OF β-RAY DOSIMETRY. K.Sommermeyer and K.H.Waechter.
Z. angew. Phys., Vol. 8, No. 2, 53-61 (1956). In German.

Previous work of the authors (Abstr. 718/1954) concerning dosage distribution from point-source β-emitters in air-equivalent substances has been completed, and results compared with those of Loevinger (Abstr. 5925/1954) and of Clark, Brar and Marinelli (Abstr. 5611/1955). Dosage distributions from point-source β-emitters within homogeneous materials of atomic number different from that of air have been determined experimentally (S^{35} in H_2, Al, A and Au; P^{32} in Al and Au) and factors evolved making it possible to determine the surface dose from homogeneous bodies of uniformly distributed high atomic number β-ray emitters. D.V.Mabbs

539.166

4612. ANGULAR CORRELATION IN Os^{188}. V.R.Potnis, V.S.Dubey and C.E.Mandeville.
Phys. Rev., Vol. 102, No. 2, 459-61 (April 15, 1956).

The quantum radiations of Re^{188} have been examined with the aid of coincident scintillation spectrometers. In addition to those already known, gamma rays have been detected at energies of 1300 and 1770 keV. The spatial correlation function of the 480 keV–150 keV cascade has been determined and corresponds to a 2-2-0 scheme with E2 heavily mixed (99.56%) in the case of the 480 keV transition. A.

539.166

4613. INNER BREMSSTRAHLUNG EMITTED IN ELECTRON CAPTURE DECAY OF Ni^{59}, A^{37}, AND Fe^{55}. B.Saraf.
Phys. Rev., Vol. 102, No. 2, 466-73 (April 15, 1956).

The continuous gamma-ray spectra (inner bremsstrahlung) accompanying orbital electron capture in Ni^{59}, A^{37} and Fe^{55} have been studied with the use of a scintillation spectrometer of NaI(Tl). The shape of the spectrum of Ni^{59} has been found to correspond to a 2nd forbidden spectrum ($\Delta I = 2$, No) and differs distinctly from that of an allowed one. The parameter, λ, of the correction factor, $C_{2S,T}$, is approximately 0.33; the value of Aij/Tij, for a pure tensor interaction, is (−6). The probability of emission of a photon of energy greater than 100 keV has been shown to be 1.4 ± 0.4 times the theoretical value. The spectrum of A^{37} has an allowed shape at energies as low as ~ 35 keV, and the ratio of emission probabilities P(exp)/P(theoret) is 1.05 ± 0.25 for the region of energy lying above 35 keV. The spectrum of Fe^{55} has been compared with the calculations of Glauber and Martin. In this case, the value of P(exp)/P(theoret) is 1.1 ± 0.3 at higher energies. A.

539.166

4614. GAMMA RAYS FROM NEUTRON INELASTIC SCATTERING. R.B.Day.
Phys. Rev., Vol. 102, No. 3, 767-87 (May 1, 1956).

A NaI scintillation counter has been used to observe gamma-rays from neutron inelastic scattering in B^{10}, C, N, O, F, Mg, Al, S, Ca, Fe, Ni, Cu, Ta, Pb and Bi. In most cases these gamma-rays can be fitted into known level schemes of the target nuclides; however, a few gamma-rays require the existence of previously undetected levels. In addition, several gamma-rays have been observed from $(n, p'\gamma)$ and $(n, \alpha'\gamma)$ reactions. The problems involved in measuring absolute cross-sections for the production of gamma-rays are considered in detail. The usefullness of neutron inelastic scattering in nuclear spectroscopy is illustrated in several cases. A.

539.166

4615. RADIATION FROM EXCITED STATES OF CARBON-13. R.J.Mackin, Jr, W.R.Mills, Jr and J.Thirion.
Phys. Rev., Vol. 102, No. 3, 802-5 (May 1, 1956).

A scintillation spectrometer and a magnetic lens spectrometer have been used to study gamma-rays from excited states of C^{13} at 3.84 and 3.68 MeV, produced in the reactions $C^{12}(d, p)C^{13*}$ and $B^{10}(\alpha, p)C^{13*}$. Lines have been measured at

169.5 ± 0.4 keV, 3.844 ± 0.015 MeV, and 3.69 ± 0.02 MeV. The last one was shown to exhibit a Doppler shift, suggesting a lifetime less than 3×10^{-13} sec. The 170 keV line was shown to result from a transition between the 3.84 and 3.68 MeV levels, indicating a level energy 3.675 ± 0.015 MeV. Its internal conversion coefficient was found (assuming an isotropic distribution) to be $(1.4 \pm 0.3) \times 10^{-4}$, consistent with electric dipole radiation. Lack of knowledge of the angular distribution adds to the uncertainty and makes it impossible to rule out magnetic dipole radiation. Relative line intensities showed that the upper level decayed through the 3.68 MeV level with a probability 0.24 ± 0.05. Transitions to the 3.1 MeV level were not detected and were concluded to have intensities less than 3% of the ground-state transitions. A.

539.166

4616. DECAY OF As^{72}. E.Brun, J.J.Kraushaar and W.E.Meyerhof.
Phys. Rev., Vol. 102, No. 3, 808-13 (May 1, 1956).

The gamma-rays following the decay of As^{72} have been studied with scintillation spectrometers both single and in coincidence. Sixteen gamma-rays have been resolved and have necessitated the addition of levels at 2.91 and 3.74 MeV to the levels of Ge^{72} known from previous studies of the radiations of Ga^{72}. From delayed coincidence measurements gamma-rays of 1.75, 2.24 and 3.0 MeV, in addition to annihilation radiation, have been observed to populate the isomeric (0^+) state in Ge^{72} at 0.69 MeV. A.

539.166

4617. GAMMA-GAMMA ANGULAR CORRELATION IN THE DECAY OF CHLORINE-34. H.E.Handler and J.R.Richardson.
Phys. Rev., Vol. 102, No. 3, 833-6 (May 1, 1956).

The directional angular correlation between the 1.16 and 2.10 MeV gamma-rays which follow the decay of 32.4 min Cl^{34} has been measured. Samples of Cl^{34} were produced in the cyclotron by the (p, pn) reaction and were produced in both solid and liquid form. Sodium iodide scintillation counters with subsequent pulse-height discrimination and standard coincidence techniques were used and the method was tested on the cascade of Ni^{60} giving satisfactory agreement with previous results. The results on S^{34}, although not unambiguous, are consistent with the assignment of spin 2 and even parity to both the first and second excited states of S^{34} with the 1.16 MeV gamma-ray being 1.7% electric quadrupole and 98.3% magnetic dipole radiation. A.

539.166

4618. NUCLEAR RESONANCE SCATTERING OF γ-RAYS BY V^{51}. H.Schopper.
Z. Phys., Vol. 144, No. 5, 476-87 (1956). In German.

The resonance scattering of the 325 keV γ-ray of Cr^{51} (following K-capture) in V_2O was investigated. Recoil energy losses were compensated either by heating the Cr^{51} to 1200° C, or by utilizing the neutrino-recoil of a gaseous source. The ½-life of the first excited state of V^{51} is $(1.5 \pm 0.3) \times 10^{-10}$ sec. A.O.Stanesby

539.166 : 539.172.11/.13

GAMMA RAYS FROM BOMBARDMENT OF Be^9, C^{13} AND N^{14}. See Abstr. 3977

539.166.08 : 537.533

4619. DETERMINATION OF THE GAMMA SPECTRUM FROM A 30 MeV BETATRON USING A COMPTON SPECTROMETER. K.Ulmer and B.Ziegler.
Z. angew. Phys., Vol. 8, No. 2, 49-53 (1956). In German.

The γ spectrum is analysed in terms of the β spectrum of the recoil electrons. Although the total cross-section for Compton scattering is a decreasing function of energy, the differential cross-section for recoil electrons ejected in the direction of the incident γ-rays, increases with energy, and can therefore be used for spectrometric determinations in this, and possibly higher energy ranges. The γ-rays are scattered by a thin beryllium foil, and the forward travelling recoil electrons analysed, using a 60° sector magnet, followed by a scintillation counter. Correction factors are calculated for the effects of energy loss and multiple scattering in the foil, and are confirmed experimentally by measurements on foils of different thickness. An experimental accuracy of ± 5% is claimed. E.A.Ash

539.166.74

4620. ANGULAR DISTRIBUTION OF MULTIPLY SCATTERED GAMMA RADIATION FROM A PLANE ISOTROPIC SOURCE. M.J.Berger.
J. appl. Phys., Vol. 26, No. 12, 1504-7 (Dec., 1955).

A method is given for calculating, within the framework of the moment-method of Spencer and Fano, the angular distribution of radiation from a plane isotropic source. Essential use is made of the simplification introduced by a geometrical feature of radiation from such a source. Sample calculations are presented for a 1 MeV source in water. A.

539.166.74

4621. THE COHERENT SCATTERING OF γ-RAYS BY K ELECTRONS IN HEAVY ATOMS. III. THE SCATTERING OF 0.64 mc^2 γ-RAYS IN MERCURY. G.E.Brown and D.F.Mayers.
Proc. Roy. Soc. A, Vol. 234, 387-90 (Feb. 21, 1956).

For Pt II, see Abstr. 2155 (1955). The results of calculations for the coherent scattering of γ-rays of energy 0.64 mc^2 are given in the form of scattering amplitudes as functions of angle. Values for the photoelectric effect at 0.32 mc^2 and 0.64 mc^2 are reported. A.

539.166.83

4622. MEASUREMENT OF THE K FLUORESCENCE YIELD AND STUDY OF THE K AUGER RAYS OF Tc^{99}_{43} (6.04 hr) AND In^{115}_{49} (4.5 hr). J.Laberrigue-Frolow and P.Radvanyi.
C.R. Acad. Sci. (Paris), Vol. 242, No. 7, 901-4 (Feb. 13, 1956). In French.

β-spectrometer measurements of the K-conversion and K Auger rays enabled relative fluorescence yields (R_k) to be determined. The results are: Tc^{99} (140 keV γ-ray), $R_K = 0.70 \pm 0.03$; In^{115} (334 keV γ-ray), $R_k = 0.87 \pm 0.03$. Relative intensities of the Auger groups, and K/(L + M) conversion ratios are also reported. J.J.Wilkins

539.166.83

4623. L-AUGER ELECTRONS ACCOMPANYING THE DISINTEGRATION OF THE ELEMENTS OF THORIUM ACTIVE DEPOSIT. A.Moussa and J.B.Bellicard.
C.R. Acad. Sci. (Paris), Vol. 242, No. 9, 1156-9 (Feb. 27, 1956). In French.

Measurements with a double-focusing β-spectrometer are reported. An overall yield of 0.32 L-Auger electrons per disintegration is deduced. Energies and identifications are listed for 20 individual groups. J.J.Wilkins

539.166.83

4624. THE CONVERSION ELECTRON CORRELATION OF Hg^{197} AND Ta^{181}. F.Gimmi, E.Heer and P.Scherrer.
Helv. phys. Acta, Vol. 28, No. 5-6, 470-2 (1955). In German.

The measurements seem to indicate clearly the existence of a magnetic reduction of the $e_K^- - \gamma$ angular correlation by the excited electron shell. A.O.Stanesby

539.166.83

4625. RELATIVE CONVERSION PROBABILITIES IN THE K, L_I and L_{II} SHELLS OF THE 238.6 keV γ- LINE OF ThB. E.Sokolowski, K.Edvarson and K.Siegbahn.
Nuclear Physics, Vol. 1, No. 3, 160-3 (1956).

These were measured in a high-resolution double-focusin spectrometer, and are in good agreement with the theoretical values. A.O.Stanesby

539.166.835

4626. ANGULAR CORRELATION OF PAIR ELECTRONS FROM THE 4.43 MeV γ-RADIATION OF CARBON 12. MEASUREMENT OF THE MULTIPOLARITY OF THIS RADIATION. S.Gorodetzky, R.Armbruster, P.Chevallier and A.Gallmann. C.R. Acad. Sci.(Paris), Vol. 242, No. 7, 898-901 (Feb. 13, 1956). In French.

The angular correlation has been measured for internally produced pairs, using scintillation spectrometer methods (see Abstr. 2201/1956). Comparison with theory indicates E2 radiation. J.J.Wilkins

NUCLEAR REACTIONS 539.17

539.17 : 537.521

4627. THERMONUCLEAR FUSION. GAS DISCHARGE RESEARCH IN THE SOVIET UNION. I.V.Kurchatov. Engineering (London), Vol. 181, 322-5 (May 11, 1956).

A slightly abridged reprint, with the original diagrams and photographs, of the lecture abstracted in Abstr. 3974 (1956).

539.172

4628. AVERAGE NUMBER OF NEUTRONS PER FISSION FOR SEVERAL HEAVY-ELEMENT NUCLIDES. W.W.T.Crane, G.H.Higgins and H.R.Bowman. Phys. Rev., Vol. 101, No. 6, 1804-5 (March 15, 1956).

The relative average number of neutrons per fission, $\bar{\nu}$, of several spontaneous fissioning nuclides has been measured by making use of the coincidence between fission events and neutrons detected in a LiI(Eu) crystal. A.

539.172

4629. STATISTICAL THEORY OF NUCLEAR FISSION: ASYMMETRIC FISSION. P.Fong. Phys. Rev., Vol. 102, No. 2, 434-48 (April 15, 1956).

A statistical theory is developed, according to which the relative probability of a mode of fission is determined by the total excitation energy of its two fragments calculated at the moment just before separation. In order to calculate the excitation energy, the well known semiempirical atomic mass formula is corrected for its deviations known to be attributed to the effects of nuclear shells. The nuclear level density expression is studied empirically with special attention to shell effects. These results are used for a quantitative calculation of the relative probabilities of all possible modes of fission. The mass distribution curve of fission products of U^{235} induced by thermal neutrons is derived and compared with experimental results. Applications of the statistical theory to charge distribution, kinetic energy distribution, variations of mass, charge and energy distributions with respect to target nucleus and incident energy, prompt neutron distribution, spontaneous fission yields, and ternary fission are discussed briefly. A.

539.172

4630. PROMPT NEUTRONS FROM THE SPONTANEOUS FISSION OF FERMIUM-254. G.R.Choppin, B.G.Harvey, D.A.Hicks, J.Ise, Jr and R.V.Pyle. Phys. Rev., Vol. 102, No. 3, 766 (May 1, 1956).

The average number of prompt neutrons emitted has been measured to be 4.05 ± 0.19 (standard error). A.

539.172

4631. SPONTANEOUS FISSION KINETICS OF Cf^{252}. A.B Smith, A.M.Friedman and P.R.Fields. Phys. Rev., Vol. 102, No. 3, 813-15 (May 1, 1956).

A double ionization chamber was used to determine the spontaneous fission modes of Cf^{252} [$\tau_{1/2}$(fission) = 66 years]. The most probable energies of the light and heavy fragments were found to be 107 and 79 MeV, respectively. The asymmetry of the process is found to agree with chemical mass-yield determinations. The results of the experiment are compared with the kinetics of other fission processes. A.

539.172

NUCLEAR REACTIONS DUE TO COSMIC RAYS. See also under "Cosmic rays". Decimal classification 537.591.8

539.172

4632. INELASTIC SCATTERING OF π-MESONS ON CARBON. M.Della Corte, T.F.Fazzini and A.M.Sona. Nuovo Cimento (Ser. 10), Vol. 2, No. 6, 1345-9 (Dec., 1955).

A number of inelastic scattering events have been found in emulsion exposed to $\pi^{\pm}$-meson beams of energy between 60 and 125 MeV. In certain cases it has been possible to identify the reaction type; those identified as inelastic scatterings from carbon have been analysed. The cross-section for the tripartition of carbon has been found to be about 10% of the geometric value. A minimum for the cross-section is found between scattering angles of 50 and 90°. Whether or not the tripartition proceeds via Be^8 is discussed; the evidence is found to be against the participation of Be^8. D.J.Prowse

539.172

4633. ON THE INELASTIC SCATTERING OF ELECTRONS FROM ^{12}C. G.Morpurgo. Nuovo Cimento (Ser. 10), Vol. 3, No. 2, 430-7 (Feb., 1956).

The theoretical interpretation of Fregeau and Hofstadter's experiment on the elastic and inelastic scattering of high-energy electrons from C^{12} is discussed; the excitation of the 4.43 MeV level is particularly considered, and the increase of the ratio $d\sigma_{inelastic}/d\sigma_{elastic}$ with the energy is explained as well as the constancy of $d\sigma_{inelastic}$ in the interval 80—187 MeV. Calculations are performed with the use of an oscillator shell model both in LS and JJ coupling. The quantitative agreement is satisfactory and better (by a factor of three) with LS than with JJ coupling. A.

539.172 : 537.591.8

4634. THE SOLUTION OF THE G-EQUATIONS OF JANOSSY WITH IONIZATION LOSS. J.Lopuszański. Acta phys. Polon., Vol. 14, No. 3, 251-3 (1955).

The methods developed previously (Abstr. 3180/1956) are applied to the case of the electron—photon cascade taking into account ionization loss. G.E.Brown

539.172.1

4635. NUCLEAR REACTIONS PRODUCED BY NITROGEN ON BORON AND OXYGEN. H.L.Reynolds, D.W.Scott and Zucker. Phys. Rev., Vol. 102, No. 1, 237-41 (April 1, 1956).

The following nuclear reactions were detected from the bombardment of elemental boron and oxygen by energetic nitrogen ions: (1) $B^{10}(N^{14}, O^{15})Be^9$, (2) $B^{10}(N^{14}, N^{13})B^{11}$, (3) $B^{10}(N^{14}, C^{11})C^{13}$, (4) $B^{10}(N^{14}, F^{18})Li^6$, (5) $B^{11}(N^{14}, p)Na^{24}$, (6) $O^{16}(N^{14}, 2p)Al^{28}$ and (7) $O^{16}(N^{14}, F^{18})C^{12}$. The yields for these reactions were differentiated to obtain the cross-sections as a function of energy. Reactions (2) and (3) can be identified as stripping reactions by comparison with similar proton-induced reactions and by comparison with previously studied nitrogen-induced reactions. Only a small part of reaction (1) seems to proceed through a stripping reaction although it should be similar to reaction (3). Reactions (1) and (4) are compared to proton-induced reactions in Na^{23} which lead to the same residual radioactive nuclei. The nitrogen-induced reactions are more probable by factors of 4 and 2, respectively, after barrier corrections, indicating that the nitrogen- and proton-induced reactions proceed through somewhat different mechanisms. The reactions observed in the bombardment of oxygen are compared to proton-induced reactions in Si^{29}. The $(N^{14}, 2p)$ and (p, 2p) excitation functions may be similar but the lack of barrier penetration calculations prohibits accurate comparisons. A.

539.172.1

4636. NITROGEN-INDUCED NUCLEAR REACTIONS IN ALUMINUM. W.H.Webb, H.L.Reynolds and A.Zucker. Phys. Rev., Vol. 102, No. 3, 749-52 (May 1, 1956).

Aluminium foils were bombarded with 25.5 MeV nitrogen ions from the 63 inch cyclotron, and the following radioactive reaction products were separated chemically and identified: C^{11}, N^{13}, F^{18}, Na^{24}, Cl^{38}, K^{38}, and P^{32}. The deflected cyclotron beam was used to study the cross-sections for the three reactions, $Al^{27}(N^{14}, N^{13})Al^{28}$, $Al^{27}(N^{14}, 3p)Cl^{38}$ and $Al^{27}(N^{14}, p2n)K^{38}$, for energies from 19.5 to 25.5 MeV. It was found that over this energy range the cross-section for the (N^{14}, p2n) reaction is about fifty times greater than for the (N^{14}, 3p) reaction, as would be expected from the statistical theory for the decay of the compound nucleus. A search was made for Si^{31} and Mg^{27}. The upper limits for the respective yields are 3×10^{-11} and 9×10^{-11} nuclei formed per incident particle at 25.5 MeV. The range-energy relation for nitrogen ions in aluminium was measured. A.

539.172.13

4637. ON THE OBSERVATION OF AN ANTIPROTON STAR IN EMULSION EXPOSED AT THE BEVATRON. O.Chamberlain, W.W.Chupp, G.Goldhaber, E.Segrè, C.Wiegand, E.Amaldi, G.Baroni, C.Castagnoli, C.Franzinetti and A.Manfredini.
Nuovo Cimento (Ser. 10), Vol. 3, No. 2, 447-67 (Feb., 1956).

In connection with the antiproton investigation at the Bevatron several stacks of nuclear emulsions have been exposed in a magnetically selected beam of negative particles. The selected particles were produced in a copper target, bombarded with protons of 6.3 GeV, and had a momentum of 1.09 GeV/c. The experiments were designed to observe the annihilation process undergone by an antiproton brought to rest inside the emulsion. The details of the investigation are given, and an estimate of the number of expected annihilation stars as obtained from previous measurements with counter experiments reported by Chamberlain, Segrè, Wiegand and Ypsilantis. The only event found so far is described. The mass of the primary particle responsible for it, as obtained from a weighted average using several independent methods is $(1824 \pm 51)\, m_e$. The star produced by it is associated with a minimum release of a "visible" energy of ~826 MeV while the corresponding unbalanced "visible" momentum amounts to ~ 520 MeV/c. A.

539.172.13

4638. ABOUT THE CAPTURE AND ANNIHILATION OF ANTIPROTONS. R.Gatto.
Nuovo Cimento (Ser. 10), Vol. 3, No. 2, 468-72 (Feb., 1956).

The mechanism of annihilation of antiprotons is discussed. It is shown that large multiplicities for the number of pions emitted should be infrequent and some considerations are reported concerning the average number of neutral pions to be expected. It is suggested that a K–K pair could also be emitted. An event recently found and interpreted as due to the annihilation of an antiproton is discussed, and it is shown that, using Gell-Mann's model, arguments can be given against its interpretation in terms of a new long-lived heavy boson. A.

539.172.13

4639. PROTON-INDUCED REACTIONS IN Na^{23}, Al^{27}, AND Si^{29}. B.L.Cohen.
Phys. Rev., Vol. 102, No. 2, 453-5 (April 15, 1956).

Cross-sections and excitation functions were measured for various reactions in Na^{23}, Al^{27} and Si^{29} induced by 32 MeV protons from the Berkeley linear accelerator. These are compared with measurements by Reynolds and Zucker for reactions induced by 26 MeV N^{14} ions in B^{10}, N^{14} and O^{16}; the same compound nuclei at the same excitation energies are involved. The N^{14}-induced reactions in which nearly equal-mass nuclei are emitted have much larger cross-sections than the corresponding proton-induced reactions; this indicates that the former do not proceed by fission of a compound nucleus. Various spallation reactions were observed to have comparable cross-sections in the two types of bombardments. A.

539.172.13

4640. SHELL-MODEL COUPLING AND ANGULAR DISTRIBUTION OF THE REACTION $C^{13}(p\gamma)N^{14}$. O.Hittmair.
Z. Naturforsch., Vol. 11a, No. 1, 94-5 (1956). In German.

The distribution is calculated for intermediate coupling starting from the LS-wavefunctions and diagonalizing the interaction matrix. L.Pincherle

539.172.13

4641. ELASTIC SCATTERING (d, p) AND (d, C^{12}) FOR 7.86 MeV DEUTERONS. J.Catalá, F.Senent and J.Aguilar.
An. Real. Soc. Espan. Fís. Quím., Vol. 52(A), No. 1-2, 27-32 (Feb., 1956). In Spanish.

A study of the angular distributions of the elastically scattered protons from acetylene gas produced by 7.86 MeV deuterons, using a photographic technique. A graph is given of differential cross-section against angle of proton emission, compiled from over fourteen thousand proton tracks at fourtee different angles from 15° to 60°. The curve is asymmetric, with maxima at about 40° and 60° and minima at 55° and 80° from an arbitrary axis. At 22½°, the range of the recoil protons was of the same order as that of the incident deuteron diffused from C^{12} nuclei in the acetylene, and a technique described earlier was used. (See Abstr. 11394/1954). The differential cross-section is expressed as a series in Legendre polynomials, the first eight terms of which are sufficient to allow agreement with the results obtained to within the experimental error. An earlier paper, (Abstr. 9593/1954) is completed, concerning the angular distribution in the centre-of-mass system of deuterons elastically scattered from C^{12}. J.J.Phipps

539.172.1

4642. INFLUENCE OF THE STATISTICAL FACTOR ON (d,p) CROSS SECTIONS. P.M.Endt and C.M.Braams.
Physica, Vol. 21, No. 10, 839-40 (Oct., 1955).

It is shown that the differences in intensity of the proton groups from different isotopes can be explained by the influence of the statistical factor $(2J_f + 1)/(2J_i + 1)$, corrected for the partial filling of the relevant neutron shell. J.Hughes

539.172.13

4643. SHELL-MODEL COUPLING AND THE POLARIZATION OF THE PROTONS FROM STRIPPING. O.Hittmair.
Z. Phys., Vol. 144, No. 5, 449-54 (1956). In German.

A completely general expression is obtained for the proton polarization in a (d, p) reaction. The degree of polarization is calculated for the reaction $N^{13}(d, p)N^{14}$ under the restriction that the interaction between the nucleus and the proton is pure potential scattering. For any angle of emission the proton polarization is $\leq 1/3$. J.Hughes

539.172.13

4644. DISINTEGRATIONS OF ISOTOPES OF LITHIUM, CARBON AND OXYGEN BY TRITONS OF 0.9 MeV. R.Barjon, D.Magnac-Valette and J.Schmouker.
C.R. Acad. Sci (Paris), Vol. 242, No. 7, 896-8 (Feb. 13, 1956). In French.

Thin targets of Li^6, Li^7 and O and a thick target of C were bombarded with tritons accelerated to a known energy about 0.9 MeV by the Van de Graaff accelerator at the Ecole Polytechnique. Secondary particles emitted at right angles to the initial analysed beam were detected by nuclear emulsions. Peaks and continuous distributions were observed in range-histograms of alpha particles which could be identified as due to various reactions, including some giving rise to He^5. J.H.Fremlin

539.172.

4645. IMPLICATIONS OF THE PHOTONUCLEAR EFFECT IN Zr^{90}. P.Axel and J.D.Fox.
Phys. Rev., Vol. 102, No. 2, 400-14 (April 15, 1956).

The reactions $Zr^{90}(\gamma, n)Zr^{89}$ and $Zr^{90}(\gamma, n)Zr^{89m}$ have been studied in detail. The threshold for $Zr^{90}(\gamma, n)Zr^{89m}$ is 12.37 ± 0.09 MeV; that for $Zr^{90}(\gamma, n)Zr^{89}$ is 11.78 ± 0.09 MeV. A discussion is given of the precision of (γ, n) threshold determinations and of the error sometimes introduced because of large spin differences. The detailed shape of the (γ, n) cross-section is used to obtain data on both the absorption mechanism of gamma-rays and the competition between the emission of neutrons and gamma-rays by a compound nucleus. At about 12.4 MeV in Zr^{90}, less than 60% of the absorption occurs by the E1 process if E2 is the only other absorption process. If both M1 and E2 absorption occur equally, only about 10% of the absorption is E1. The competition between gamma-ray and neutron emission could not be obtained quantitatively but the results are consistent with other quite different measurements of this competition. A.

539.172.3

4646. YIELDS AND EXCITATION CURVES FOR THE HIGH-ENERGY PHOTOSPALLATION OF COBALT. R.L.Wolke and W.A.Bonner.

Phys. Rev., Vol. 102, No. 2, 530-4 (April 15, 1956).

Yields of several nuclides from the gamma-ray spallation of cobalt have been measured, using bremsstrahlung from the Cornell 300 MeV electron synchrotron. With 309 MeV bremsstrahlung, the yields are of the order of 1/200 times the (γ, n) cross-section. A general decrease of yield with increasing number of ejected nucleons was found. Excitation curves for some of the reactions were determined from 174 to 309 MeV. The results indicate that the $(\gamma, 2pn)$ reaction is caused primarily by photons of energy less than 174 MeV, while the $(\gamma, 2p5n)$, $(\gamma, 2p6n)$, and $(\gamma, 3p7n)$ reaction yields are contributed to by higher-energy photons. The average "effective photon" energy is found to increase with increasing number of ejected nucleons. A.

539.172.3

4647. PHOTOEJECTION OF HIGH-ENERGY NUCLEONS FROM NUCLEI AND THE QUASI-DEUTERON MODEL. I. CROSS SECTIONS AND ANGULAR DISTRIBUTIONS. A.C.Odian, P.C.Stein, A.Wattenberg, B.T.Feld and R.Weinstein.

Phys. Rev., Vol. 102, No. 3, 837-43 (May 1, 1956).

Experiments are described on the photoproduction of high energy neutron-proton pairs from complex nuclei. The results provide further confirmation and some clarification of the quasi-deuteron model of Levinger. In these experiments targets of D, Li, and O were bombarded by a 340 MeV bremsstrahlung beam. In one set of measurements, intended to check the kinematical features of the model, the angular spread was observed of the n–p coincidences which arises from the momentum distribution of nucleons in the complex nuclei. These observations were preliminary to the main group of measurements, which consisted in a direct comparison of the cross-sections and angular distributions of quasi-deuteron disintegrations for Li and O to those from D for 260 MeV photons. (A more limited group of measurements are reported for 200 MeV photons.) The results of these observations indicate that the quasi-deuteron photodisintegration proceeds through the same mechanisms as are responsible for the photodisintegrations of free deuterons at the energies investigated. However, a quantitative understanding of the data, especially for the cross-section ratios, required an analysis of the effects of scattering of the emerging nucleons in the target nuclei. Qualitative arguments concerning these effects are given. A.

539.172.4

4648. THE NUCLEAR SCATTERING OF 14 MeV NEUTRONS. P.Harihar, V.B.Kelkar, G.Z.Shah and K.M.Gatha.

Curr. Sci., Vol. 24, No. 11, 368-9 (Nov., 1955).

Amaldi et al. have observed the scattering of 14 MeV neutrons from various nuclei and found that nuclear radii vary according to the equation $R = (R_0 + \bar{R} A^{1/3})$ using the opaque nuclear model interpretation. The existence of the term R_0 has been thought to be due to the use of the approximate expression $\sigma_t = 2\pi R^2$ for the scattering cross-section. The exact expression has therefore been used and the value of R_0 reduced from $(1.11 \pm 0.26) \times 10^{-13}$ to $(0.57 \pm 0.27) \times 10^{-13}$ cm. That R_0 does not disappear completely may indicate a systematic error in Amaldi's experimental results or the inadequacy of the opaque model interpretation to explain neutron scattering at 14 MeV. D.R.Chick

539.172.4

4649. ON THE SCATTERING OF NEUTRONS BY α PARTICLES. E.Clementel and C.Villi.

Nuovo Cimento (Ser. 10), Vol. 2, No. 5, 1121-6 (Nov., 1955).

It is pointed out that the phase-shift analysis of n, α scattering is mathematically identical to the analysis of π, p scattering. A mechanical computer, originally constructed for the latter problem, is used to work out n, α phase-shifts, assuming both normal and inverted order for the He^5 doublet. J.M.Cassels

539.172.4

4650. AVERAGE CROSS-SECTIONS FOR THE REACTIONS $^{32}S(n,p)^{32}P$ AND $^{31}P(n,p)^{31}Si$ WITH FISSION NEUTRONS. B.Grimeland.

Nuovo Cimento (Ser. 10), Vol. 2, No. 6, 1336-9 (Dec., 1955).

It is argued that the ratio of the cross-sections for the sulphur and phosphorus reactions, averaged over the fission fast neutron spectrum, is about $2\frac{1}{2}$ and not 1.58 as given by Hughes (Abstr. 5976/1954). J.M.Cassels

539.172.4

4651. NEUTRON ABSORPTION CROSS SECTIONS OF U^{235} AND Pu^{239} IN THE 5- TO 50-keV ENERGY RANGE. R.L.Macklin, H.W.Schmitt and J.H.Gibbons.

Phys. Rev., Vol. 102, No. 3, 797-9 (May 1, 1956).

The cross-sections were measured at six energies in the 5 to 50 keV energy range. Neutrons from the reaction $V^{51}(p,n)Cr^{51}$ were used in spherical-shell transmission measurements. The results show, in general, a decrease in absorption cross-section with increasing energy up to about 30 keV and then a nearly constant value (up to 50 keV) of about 2.8 barns for U^{235} and 2.2 barns for Pu^{239}. A.

539.172.4

4652. NEUTRON CROSS SECTION OF XENON-135 AS A FUNCTION OF ENERGY. S.Bernstein, M.M.Shapiro, C.P.Stanford, T.E.Stephenson, J.B.Dial, S.Freed, G.W.Parker, A.R.Brosi, G.M.Hebert and T.W.DeWitt.

Phys. Rev., Vol. 102, No. 3, 823-30 (May 1, 1956).

This was measured, using as velocity selector a focusing-type single-crystal spectrometer designed for transmission measurements of very small samples. The total cross-section in the energy interval from 0.015 eV to 0.20 eV was measured. The samples, produced from neutron irradiated uranium metal, were in the form of PdI_2 and were contained in sealed Pyrex capillary tubing. The largest initial strength of the samples was 10 curies of I^{135} activity, corresponding to 12×10^{15} atoms of I^{135}. The daughter Xe^{135} grew from the I^{135} as a known function of time, reaching a maximum value of about 5×10^{15} atoms of Xe^{135} 11.3 hr after the I^{135} begins to decay. In the absolute assay of sample strengths, absolute β counting of pure I^{135} samples, and β-γ coincidence counting of pure Xe^{135} samples served as primary standards. Hard gamma-rays from I^{135} served as a secondary standard. The total cross-section of one entire sample of Xe was of the order of 1.5 mm^2. The transmission of the sample was measured during the period of growth and decay of the Xe. The radioactive sample was placed inside the shield of the ORNL graphite reactor. A thermal beam of neutrons from the reactor was allowed to pass longitudinally through the sample along the axis of the capillary tube onto the quartz crystal spectrometer. The desired energies were selected by use of the Bragg reflection law, $\lambda = 2d \sin\theta$. A resonance in the cross-section of Xe^{135} was

discovered at 0.085 eV. The total cross-section measurements were fitted to the single-level Breit–Wigner formula equally well with the following two sets of parameters: $g = \frac{3}{8}$, $E_0 = 0.0851 \pm 0.0011$ eV, $\Gamma_n^0 = 0.0305 \pm 0.0008$ eV, $\Gamma\gamma = 0.0828 \pm 0.0031$ eV; $g = \frac{5}{8}$, $E_0 = 0.0849 \pm 0.0010$ eV, $\Gamma_n^0 = 0.0182 \pm 0.0005$ eV, $\Gamma\gamma = 0.0942 \pm 0.0032$ 2V. E_0 is the resonance energy, Γ_n^0 is the neutron width at resonance, $\Gamma\gamma$ is the gamma-ray width of the level, and g is the statistical weight factor. The factor g has two possible values because the spin of the compound state is not known. The capture cross-section at resonance for state with $g = \frac{5}{8}$ is 55% of the theoretical maximum possible, and the corresponding capture cross-section for the state with $g = \frac{3}{8}$ is 80% of the theoretical maximum value. A.

539.172.4

4653. THE TESTING OF MATERIALS BY THE OSCILLATION METHOD AT THE CHÂTILLON PILE. D.Breton.
Onde élect., Vol. 35, 837-46 (Oct., 1955). In French.

Measurements were made of the amplitude and phase of the variations in neutron density at a point near an oscillating graphite plunger in the Châtillon pile. The pile power, and the frequency, mean position, and amplitude of the oscillations, were adjusted to find the best conditions for observing changes of phase when boron was added to the standard graphite plunger. The arrangement could then be used to test other graphite plungers for neutron-capturing impurities. Other applications are briefly mentioned. J.M.Cassels

539.172.4

4654. AMERICAN DEVELOPMENTS IN REACTOR TECHNIQUE IN ACCORDANCE WITH PUBLISHED DATA UP TO 1954. P.R.Arendt.
Z. angew. Phys., Vol. 7, No. 12, 593-605 (1955). In German.

A review of American work leading up to the present reactor programme of the United States with special reference to the new information given at the first International Congress of Nuclear Engineering at Ann Arbor in June 1954. A number of important elementary functions are given for the various types of reactor. These reactors are described and their working explained. The bibliography is extensive and the article forms a useful general survey of the subject.

D.J.Prowse

ATOM AND MOLECULE BEAMS. MESONS. NEUTRONS 539.18

539.18

4655. MESONS AND HYPERONS. M.M.Shapiro.
Amer. J. Phys., Vol. 24, No. 4, 196-204 (April, 1956).

Basic properties of L-mesons, K-mesons, and hyperons a are summarized in the light of evidence available in mid-1955. Masses, decay schemes, lifetimes, and Q-values are tabulated. The accompanying notes describe how 'best-values' were arrived at, and serve as a guide to a representative selection of references on unstable particles. A.

539.18

4656. CLASSIFICATION OF THE EISENBERG AND SIMILAR EVENTS. R.G.Sachs and S.B.Treiman.
Nuovo Cimento (Ser. 10), Vol. 2, No. 6, 1331-3 (Dec., 1955).

The Eisenberg event (E-event) (Abstr. 1225/1955) together with two Wisconsin events (Abstr. 5650/1955, 686/1956) w_1 and w_2 are given a consistent explanation in terms of a super K-particle K_S with I-spin $\frac{1}{2}$ (zero and negative charge) and attribute a = 2 (see Abstr. 9940/1955). The odd–even rule relating a to the I-spin must however be relaxed, in contradiction to the interpretation of the attribute concept by Gell-Mann (1952) and Nishijima (1953). Slow decay $K_S \rightarrow K_2 + \pi$ is possible, K_2 being the ordinary a = 1 K meson. The E-event is assumed to be an unstable hyperfragment with a K_S^- bound to a neutron. Slow interaction with this neutron (violating either $\Delta a = 0$ or $\Delta I = 0$) is possible by four mechanisms each giving a different mass for the K_S. Choice of the mechanism $E: (K_S^- + N^0)_{\text{bound}} \rightarrow \Sigma^0 + K_2^- + 5$ MeV makes possible a consistent explanation of E, w_1 and w_2 events ($w_1: K_S^- + N^0 \rightarrow \Lambda^0 + K_2^- + \sim 80$ MeV and $w_2: K_S^- \rightarrow K_2^- + \pi^0$). All three events when so interpreted give a unique mass 1480 m_e for K_S. If K_S exists, then an a = −2 counterpart should also exist; it would be necessary for the production mechanism. The K_S pair threshold would be 2.5 Ge K_S nuclear binding implies a quasi-nuclear potential with possibly $K_S \rightarrow K_S + \pi_{\text{virtual}}$ as a mechanism, requiring the K_S to have spin > 0. An event of March and Block (1955) is also consistent with the above picture. R.H.W.Johnstor

539.18 : 537.591.1

4657. HEAVY UNSTABLE PARTICLES IN COSMIC RADIATION. K.Gottstein, B.Roederer, J.Roederer, N.Varshneya and P.Waloschek.
Z. Naturforsch., Vol. 11a, No. 2, 152-6 (1956). In German.

The experimental data are given of 2 τ^+-mesons, 3 excited fragments (one of which decays in flight), 1 capture o a K-meson resulting in the emission of a fast particle, and 4 $K_{\mu 2}$-particles (one of which is produced in association with a negative hyperon). A

539.1

4658. CHARGE PROPERTIES OF THE WEAK DECAY INTERACTIONS OF THE NEW PARTICLES. R.Gatto.
Nuovo Cimento (Ser. 10), Vol. 3, No. 2, 318-35 (Feb., 1956)

Relations and inequalities are given — which can be verified by experiment — between the transition probabilities of different decay modes of new particles and light hyperfragments. In particular restrictions are found for the relative probabilities of the different decay modes of charged Σ-particles, for the relative probability of the τ and of the τ' decay and for the different mesonic decay modes of the lightest Λ^0-nuclei. These restrictions follow from the hypothesis that the weak decay interactions transform in charge space as the component, which satisfies charge conservation, of a spheric tensor of rank $\frac{1}{2}$. A

539.1

4659. DISINTEGRATION OF HYPERFRAGMENTS. II. W.F.Fry, J.Schneps and M.S.Swami.
Phys. Rev., Vol. 101, No. 5, 1526-35 (March 1, 1956).

For Pt I, see Abstr. 9945 (1955). A total of 32 000 cosmi ray stars, 10 000 6 BeV proton stars, 32 000 3 BeV π^--meson stars and 206 stars produced by stopped negative K-mesons were examined. Twenty hyperfragments were found in the cosmic-ray plates, 7 in the proton plates, 30 in the π^--meso plates and 11 in the negative K-meson plates. The average charge of the hyperfragments is between 4 and 5. The averag range of the hyperfragments is about 10 microns. Including previous data, only 2 mesonic decays have been found out of 98 events with Z greater than 2. A total of 7 helium hyperfra ments have been observed of which 4 decayed mesonically. O 4 hydrogen hyperfragments, all decayed with the emission of a π^- meson. In the following eight cases, it was possible to measure the total energy release in the hyperfragment disint gration, and hence to find the following values (in MeV) for th binding energy of the Λ^0 particle: ${}_\Lambda H^3(B_\Lambda = 0.6 \pm 0.6)$; ${}_\Lambda H^3(B_\Lambda = -0.5 \pm 0.6)$; ${}_\Lambda H^3(B_\Lambda = 0.4 \pm 0.7)$; ${}_\Lambda H^4(B_\Lambda = 0.5 \pm 2.0$ or $1.9 \pm 2.$ ${}_\Lambda He^4(B_\Lambda = 0.0 \pm 2.0)$; ${}_\Lambda He^4(B_\Lambda = 1.8 \pm 0.6)$; ${}_\Lambda He^5(B_\Lambda = 2.0 \pm 0.6$ ${}_\Lambda Be^9(B_\Lambda = 6.5 \pm 0.6)$. The binding energies tend to increase with increasing mass number. The fact that ${}_\Lambda H^4$ and ${}_\Lambda He^5$ hyp fragments exist, plus the fact that the binding energy of the Λ particle in ${}_\Lambda Be^9$ is greater than that of the last neutron in Be^9 shows that the Pauli principle need not be considered for a Λ particle bound in a nucleus. If the binding of the Λ^0 particle c be described in terms of a potential well the depth of the well is greater than 6.5 MeV, as indicated by B_Λ for ${}_\Lambda Be^9$. In light hyperfragments the low binding energies imply that the Λ^0

rticle spends much of its time outside the nucleus. The omentum of the Λ^0 particle has been measured in several ght hyperfragments where a π^- meson and proton were emitted, assuming it to be equal to the momentum of the π^- meson d proton. In general the momentum values are quite low, nich supports the hypothesis that the bound Λ^0 particle spends nsiderable time outside the nucleus. No further examples of nergetic hyperfragments, as have been previously reported, ere found in this work. A.

539.18

60. MESONIC vs NONMESONIC HYPERFRAGMENT ECAY. T.K.Fowler.
ys. Rev., Vol. 102, No. 3, 844-7 (May 1, 1956).

An attempt has been made to see whether reabsorption of ons, which would be produced inside a hyperfragment if the und hyperon decayed as if it were free, might account for the riking decrease, with increasing hyperfragment size, of the mber of hyperfragment decays in which a pion is actually served. Optical-model calculations, as well as experimental elds for the analogous process of photopion production inside clei, indicate that much too few pions would be reabsorbed. nother model of hyperfragment decay, in which nucleons may fluence the bound hyperon to decay without real pion emission, uld be made to fit the data. A.

539.18

361. RADIATIVE $\pi - e$ DECAY. T.Eguchi.
hys. Rev., Vol. 102, No. 3, 879-81 (May 1, 1956).

Under the assumption that the pion decay into an electron nd a neutrino is forbidden or partially forbidden, the proba- ility for a pion to decay into an electron, a neutrino, and a hoton is considered under general assumptions as to the inter- ediate state. The spectra of the electron energy in this radia- ve decay are obtained for the various types of the interaction etween the particles in the intermediate state and the leptons the final state. The total probability of the radiative decay s of the order of 10^{-8} per $\pi - \mu$ decay, except in the case of he scalar interaction where both the radiationless and radia- ve decays are forbidden. A.

539.18

662. ON GENERALISED DISPERSION RELATIONS. .Salam.
uovo Cimento (Ser. 10), Vol. 3, No. 2, 424-9 (Feb., 1956).

A relation is derived which connects the real part of the on-forward meson–nucleon scattering amplitude, to its maginary part. A.

539.18

663. ANALYTIC APPROACH FOR THE PION–PROTON CATTERING PHASE SHIFTS. W.Rarita.
hys. Rev., Vol. 102, No. 2, 486-8 (April 15, 1956).

A simple method of solving for the phase shifts of the on–proton scattering is presented. The rapid solution afforded an be utilized, as the Ashkin diagrams have been employed, to ve starting values to an electronic computer or alternatively analyse with more ease the variation of the phase shifts as a nction of the input data in terms of the coefficients of the gular distributions. A new plot of a function of the total cross ection v. the pion energy is introduced. The nearly straight ne resulting should help to evaluate the experimental data. A.

539.18 : 537.533.74

664. THEORY OF THE EFFECT OF NUCLEON–NUCLEON ORRELATIONS ON THE SCATTERING OF HIGH ENERGY LECTRONS OR MUONS BY NUCLEI. R.Gatto.
uovo Cimento (Ser. 10), Vol. 2, No. 3, 669-76 (Sept., 1955).

The zero-order calculations of Abstr. 3887 (1954) are ex- ended to an evaluation of the coherent and incoherent parts of he scattering in the 1st-order approximation, in which the ucleons of the target Fermi gas are correlated in virtue of zero-range) interactions. Graphical results for 200, 400, 600, 00, 1000 MeV muons. W.J.Swiatecki

539.18

4665. SOME COMMENTS ON K^- INTERACTIONS AT REST. J.M.Blatt and S.T.Butler.
Nuovo Cimento (Ser. 10), Vol. 3, No. 2, 409-23 (Feb., 1956).

The main conclusions of this paper are: (1) The energy spectrum of the charged π-mesons emerging from K^- captures at rest indicates, together with other evidence, that K^- capture occurs only well within nuclear matter, not at the nuclear surface. A very tentative hypothesis is suggested as an explanation, which can be tested by studying interactions in flight of K^--mesons passing through hydrogen. (2) A low energy ($<$ about 20 MeV) Λ^0 has a long mean free path in nuclear matter, at least of the order of the radius of one of the heavy nuclei in nuclear emulsions. This excludes strong Λ^0-nucleon forces of any kind, be they attractive or repulsive. (3) if a hyper-deuteron exists, it cannot be interpreted as a compound of a Λ^0 and a proton; if it emerges from a K^- capture at rest, it can also not be a compound of a K-particle and a nucleon. The only remaining reasonable interpretation, a compound of a Σ and a nucleon, violates conservation of strangeness. Experimentalists are therefore urged to measure up carefully any event suspected to be of this type. (4) Measurement of the K^+/K^- ratio in neutron bombardment of nuclei would provide a direct test of the strangeness selection rule, as distinguished from the less specific "law of associated production". A.

539.18

4666. INTERACTION OF 750-MeV π^- MESONS WITH EMULSION NUCLEI. M.Blau and A.R.Oliver.
Phys. Rev., Vol. 102, No. 2, 489-94 (April 15, 1956).

Interactions of 750 MeV π^--mesons with emulsion nuclei have been investigated. In scanning along 133 metres of meson track, several interactions with free protons and protons and neutrons at the edges of nuclei have been found; these events are discussed. The angular distribution of elastic π^-—p and π^-—n scattering is peaked in the forward direction. About 40 percent of all scatterings are inelastic with production of mesons. Characteristics of stars induced by 750 MeV π^--mesons are discussed; in particular, the relatively high frequency of stable and excited fragments in these stars seems to suggest that fragments can be emitted by direct meson interaction. A.

539.18

4667. INTERACTIONS OF NEGATIVE K MESONS. J.Hornbostel and E.O.Salant.
Phys. Rev., Vol. 102, No. 2, 502-15 (April 15, 1956).

A detailed analysis of events in nuclear emulsions caused by K^--mesons is given. Of 39 K^--mesons observed, 8 produced stars in flight, 1 underwent nuclear scattering, and 30 were captured at rest. The K^- mean free path for inelastic collisions in emulsion is 17 ± 5 cm, at most geometric. Charged hyperons and hyperfragments were seen in 12 stars; in all others, emission of a neutral hyperon is allowed by energy balance. In $\frac{2}{5}$ of the stars, a charged pion was emitted; half of the pions had kinetic energy ≥ 100 MeV. 3 stars consisted only of a Σ hyperon and a pion, of such momenta as to make it obvious that K^- capture proceeded according to: $K^- + N - Y + \pi$. Kinematic analysis shows that this reaction was the most likely process in almost all of the other captures. In 5 of the captures at rest, the pion energies were ≥ 100 MeV, compatible only with $Y = \Lambda^0$. One K^- capture reaction (and possibly a few more) was: $K^- + 2N - Y + N$. In this one capture, the hyperon is either $\Sigma^\pm$ decaying by an unusual mode, possibly into an electron, or else is a hitherto unknown particle. A.

539.18

4668. INTERACTION OF K-PARTICLES WITH NUCLEAR MATTER. W.B.Cheston.
Phys. Rev., Vol. 102, No. 2, 517-21 (April 15, 1956).

The possible acceleration in nuclear matter of the decay of a K-particle whose interaction with nuclei is intrinsically weak (the K_1-particle) is investigated. Many alternative decay

channels are afforded a K_1-particle in nuclear matter in contrast to the single mode of free K_1 decay. Decay through these alternative channels is shown to accelerate the decay but not to rates more rapid than $\sim 10^1$-$10^2 \tau$ free^{-1}. An interpretation of fragments whose total excitation exceeds that available in the case of Λ-hyperfragments in terms of a K_1-particle bound in nuclear matter seems, therefore, plausible. In addition, the absorption rates of K-particles whose interaction with nuclear matter is intrinsically strong (the K_2-particle) with and without pion emission are estimated phenomenologically. A.

539.18

4669. THE NON-MESONIC PHOTONUCLEAR REACTIONS INITIATED BY HIGH ENERGY μ-MESONS. S.Kaneko, T.Kubozoe, M.Okazaki and M.Takahata.
Progr. theor. Phys., Vol. 13, No. 4, 461-3 (April, 1955).

Four 1 + 1p stars in emulsions exposed underground are interpreted in terms of photo-nuclear excitation by low-energy (i.e. below photo-pion threshold) virtual photons associated with fast μ-mesons. Elastic two-body collisions in all cases could be excluded by kinematical considerations. The observed cross-section of $\sim 10^{-30}$ cm^2/nucleon is in rough agreement with that calculated using photon-proton excitation data and the low-energy virtual photon spectrum associated with ~ 10 BeV μ-mesons. R.H.W.Johnston

539.18

4670. p-p INTERACTIONS AT 3 BeV. R.Cester, T.F.Hoang and A.Kernan.
Phys. Rev., Vol. 100, No. 3, 940-2 (Nov. 1, 1955).

Emulsions exposed to a beam of 3 BeV protons were scanned for events which could be attributed to p-p interactions. The "along the track" scanning method was used. All events have been analysed in detail. About half are due to interactions with bound protons. The ratios for single, double and triple π-meson production have been determined and compared with the values predicted by the Fermi statistical model and by the Peaslee excited state model. In the events involving single π-production, the angular distribution in the c.m. system of the π^0 or π^+ mesons with respect to the proton of lower energy have been plotted and are strongly peaked in a forward direction. D.J.Prowse

539.18

4671. ENERGY DISTRIBUTION OF NEUTRAL MESONS PRODUCED IN COSMIC-RAY STARS. Y.B.Kim.
Phys. Rev., Vol. 102, No. 3, 882-90 (May 1, 1956).

A cloud-chamber study is reported. The cloud chamber contained a NaI scintillation crystal plate and was triggered when a nuclear interaction in the crystal caused a scintillation light pulse. Photons associated with nuclear interactions produced visible soft showers in passing through several lead plates placed below the crystal plate and their energies are estimated from the sizes of these showers. It is concluded that the majority of photons associated with cosmic-ray stars arise from the usual mode of neutral meson decay, i.e., $\pi^0 \rightarrow 2\gamma$. The energy distribution (differential) of the neutral mesons is given as a power-law spectrum of exponent $\nu = -1.5 \pm 0.2$ for π^0 energy between 400 and 900 MeV and $\nu = -2.7 \pm 0.5$ for π^0 energy between 900 and 2000 MeV. The data are consistent with an extension of the power-law spectrum given above up to a π^0 energy of about 5000 MeV. A.

539.18

4672. ELASTIC PRODUCTION OF NEUTRAL PHOTOPIONS IN HELIUM. Yoshio.Yamaguchi.
Progr. theor. Phys., Vol. 13, No. 4, 459-61 (April, 1955).

Theoretical. The T-matrix is expressed as a sum of contributions from the four nucleons:

$$T_\alpha = \langle f | \sum_{j=1}^{4} T_j | i \rangle ,$$

where $|i\rangle$ and $|f\rangle$ are the initial and final α-particle wave functions respectively. Neglecting nucleon recoil effects, assuming a cut-off Yukawa theory for the form of T_j and assuming the internal α-particle wave function to be a pure ^1S state, the following cross-section is obtained:

$$d\sigma_{el}/d\omega = 16 \times 8\, e^2 f^2 m_1^{-2} (\nu/k^3) \sin^2 \delta_{33} \sin^2 \theta \{1 + 3|\underline{\nu} - \underline{k}|^2/64\alpha^2\}^{-4}$$

where $\underline{\nu}$ and $\underline{k}$ are the proton and pion momenta and $\alpha = 236$ M is the constant in the exponent of the radial $^1S_0$ α-particle wa function. Putting in numerical valves based on pion–nucleon experimental data, differential cross-section curves are giv for $\underline{k}$ = 100 and 150 MeV/c. For comparison, cross-section curves for the case where the final α-state is not specified a given. At low energies most of the π^0-mesons are produced elastically. R.H.W.Johnsto

539.1

4673. PRODUCTION OF AN ATOMIC HYDROGEN BEAM WITH ALIGNED NUCLEAR SPINS. G.Clausnitzer, R.Fleischmann and H.Schopper.
Z. Phys., Vol. 144, No. 4, 336-43 (1956). In German.

The alignment is achieved through passing the beam through a magnetic quadrupole field, and separating one of t four components. It is suggested that if the atoms are ionize after alignment relatively intense beams of polarized proton can be produced. J.Hughe

539.185 : 539.172.1

PRODUCTION OF MONOCHROMATIC NEUTRONS WITH THE (d, d) REACTION. See Abstr. 3986

539.1

4674. PERTURBATION OF NEUTRON DENSITY OF (ABSORBENT) PROBES. M.A.Vigón and L.Díez.
An. Real. Soc. Españ. Fís. Quím., Vol. 52 (A), No. 1-2, 5-10 (Feb., 1956). In Spanish.

This depends on the nature and size of the material. Approximate equations are deduced, relating the perturbatio produced to the distances between two small, thin disks, one being used as the perturber and the other as the detecto for distances less, and greater than the radius of a disk. Experimental verification was obtained using disks of dyspr sium oxide in graphite and disks of indium in water. For graphite, the experimental values agreed with the theoretica graphs given. For water the theoretical curve falls below the results obtained when the detector approached the perturber The results and sources of error are discussed and a biblic graphy is given. J.J.Phipp

539.1

4675. THERMAL NEUTRON DISTRIBUTION DUE TO TIM DEPENDENT FAST NEUTRON SOURCES IN NON-MULTIPL ING MEDIA. S.B.D.Iyengar and G.S.Mani.
Proc. Indian Acad. Sci. A, Vol. 42, No. 4, 175-91 (Oct., 19

Neutron distributions are calculated both in the multigr approximation and by age theory, the latter being approache by letting the number of groups tend to infinity. Explicit solu tions in the two-group and age theory approximations are giv for an infinitely extended moderator, and also for a finite re tangular parallelepiped. J.M.Cassel

539.185.

4676. TECHNIQUES OF MEASURING NEUTRON SPECTR WITH THRESHOLD DETECTORS — TISSUE DOSE DETERMINATION. G.S.Hurst, J.A.Harter, P.N.Hensley, W.A.Mil M.Slater and P.W.Reinhardt.
Rev. sci. Instrum., Vol. 27, No. 3, 153-6 (March, 1956).

A method is described for measuring the spectrum of fast neutrons with a series of foil detectors. The detectors consist of Au and Au plus Cd for determining the thermal flu Pu^{239} shielded with B^{10} for determining the total fast flux, Np^{237} for determining the total flux above 0.75 MeV, U^{238} for determining the total flux above 1.5 MeV, and S^{32} for deter-

ning the total flux above 2.5 MeV. From these data the ectrum of fast neutrons can be constructed reasonably well spectra similar to that of fission. The amount of induced tivity in the detecting elements is determined with scintilla-n counters, which are calibrated by irradiation of suitable ls with thermal neutrons. Fast neutron tissue dose can be lculated from the measured spectrum. Since the foil method measuring spectra works well for high intensity bursts of utrons, dosimetry may be accomplished under conditions ere other methods, e.g., the ionization chamber and pro-rtional counter, would lead to questionable data. A.

539.185.08 : 539.172.13

77. METHODS OF CALCULATING THE ABSOLUTE FLUX F FAST NEUTRONS AND THE CROSS-SECTION FOR A JCLEAR REACTION WITH NEUTRON EMISSION BY A IOTOGRAPHIC METHOD. J.Catalá, J.Aguilar, F.Senent d R.Font.
. Real. Soc. Espan. Fís. Quím., Vol. 52(A), No. 1-2, -42 (Feb., 1956). In Spanish.

The full theory is given and applied to the authors' first sults in the study of the $Li^7(d, n)Be^8$ reaction, for the ound state of Be^8. J.J.Phipps

STRUCTURE OF SOLIDS 539.2

539.21

78. PRODUCTION OF ATOMIC DISPLACEMENTS BY GH-ENERGY PARTICLES. J.A.Brinkman.
ner. J. Phys., Vol. 24, No. 4, 246-67 (April, 1956).

The processes by which atoms in solids are displaced om their normal positions by high-energy neutrons, cyclo-on particles, and electrons are discussed. A radiation damage odel is presented which involves two basic features: (1) the oduction of interstitial atoms and vacant lattice sites, and) the production of displacement spikes. These two concepts e sufficient to account for most of the observed property anges resulting from atomic displacement by high-energy rticles. Some of the experimental results which provide the ost direct support for these concepts are presented. A.

539.21

79. THE ACTION OF RADIATION ON THE PHYSICAL ROPERTIES AND STRUCTURE OF A SOLID BODY. .I.Zakharov.
spekhi fiz. Nauk, Vol. 57, No. 4, 525-76 (1955). In Russian.

The various types of effect are discussed briefly and a neral picture given of possible primary and secondary ocesses during irradiation. Radiation effects in metals and loys are particularly well treated, with abundant tables and agrams. Other topics dealt with are the changes in proper-es and structure during irradiation of graphite, semiconduc-rs, insulators, solid molecular compounds. 90 refs., mostly papers in Phys. Rev.; only two to Soviet work.
C.R.S.Manders

539.213 : 535.343

80. CONTRIBUTION TO THE KNOWLEDGE OF ITREOUS SILICA. V.Garino-Canina.
ahiers de Phys., No. 62, 1-20 (Oct., 1955). In French.

Several methods of fusion of quartz to obtain vitreous lica are described in detail. After a general chapter on the treous state, the absorption spectrum of quartz and silica the u.v. is investigated. The absorption near 2000 A seems tirely due to impurities. Traces of iron and titanium have a rge effect which might be because they can replace Si in the O_2 "lattice". See also abstract following. C.Turner

539.213 : 535.343

681. CONTRIBUTION TO THE KNOWLEDGE OF ITREOUS SILICA. V.Garino-Canina.
Cahiers de Phys., No. 63, 35-56 (Nov., 1955). In French.

Continuation of paper reported in preceding abstract. Describes the absorption band at 2400 A and the luminescence associated with it. This band is never found in quartz. The position and intensity of the luminescence is temperature-dependent. An electric field causes movement of the centres of luminescence and absorption at 2400 A towards the cathode till they disappear. Heating over 1400° C in a reducing atmosphere will bring the absorption and luminescence back; this suggests that the absorption is due to oxygen deficiency. Heating at 1000° C for long periods or irradiation with X-rays causes additional absorption bands in the u.v.,and discoloration only for vitreous silica from fused quartz in a reducing atmosphere. C.Turner

539.216

4682. MECHANICAL BEHAVIOR OF VISCOELASTIC FIBERS. F.Akutowicz.
J. appl. Phys., Vol. 27, No. 5, 439-41 (May, 1956).

The equation $M(F, D, dF/dt, dD/dt) = 0$, where $F = F(t)$, $D = D(t)$ are measures of force and deformation and t is time, can be transformed into a first-order partial differential equation in F, D, $\partial F/\partial D$, $\partial F/\partial t$ whose characteristics represent the totality of all possible force-elongation trajectories in F, D, t space. Historically, M has seen considerable service either as a complete stress-strain relation or an element in a distribution of such relations. A geometric interpretation of M useful in rheological studies of fibres is given. Necessary conditions are given for M to provide a satisfactory description of a fibre's mechanical behaviour. An operational procedure is outlined for constructing M in the laboratory based on direct measurements instead of on a priori assumptions involving springs and dash pots. The discussion is brief and theoretical. A.

539.217

4683. DIFFUSION COEFFICIENT OF N IN α-Fe. I.Barducci.
Nuovo Cimento (Ser. 10), Vol. 3, No. 2, 350-8 (Feb., 1956).

The diffusion coefficient of N in α-Fe has been measured by many experimenters at different temperatures, but experimental values of the heat of activation and of the constant D_0 are not always in a good agreement. Some years ago Wert repeated the measurements in a more extended interval of temperatures, and observed that the agreement of actual experimental data with theoretical calculations is not so good as for some similar interstitial solid solutions. He suggested that further measurements in a more extended temperature range would probably lead to a better agreement with theory. Nevertheless an experimental investigation made by the author with the cooperation of P.Gence, has confirmed the experimental data obtained by Wert for the heat of activation and for the constant D_0. In this paper the problem is theoretically discussed and it is shown that the observed differences between theoretical and experimental results are within the limits of precision of present experimental techniques. A.

539.217

4684. SELF-DIFFUSION IN GERMANIUM. H.Letaw,Jr, W.M.Portnoy and L.Slifkin.
Phys. Rev., Vol. 102, No. 3, 636-9 (May 1, 1956).

An accurate determination of the self-diffusion coefficient in germanium has been obtained. In the temperature range 766-928° C, it is represented by $D = 7.8 \exp(-68\,500/RT) cm^2 sec$. The probable errors in the frequency factor and activation energy are ± 3.4 cm²/sec and ± 0.96 kcal/mol, respectively. A.

539.23 : 548.74

4685. ELECTRON DIFFRACTION FROM ELECTROLYTICALLY POLISHED SURFACES AFTER CATHODE SPUTTERING. A.Ladage.
Z. Phys., Vol. 144, No. 4, 354-72 (1956). In German.

A cathode sputtering unit has been built into an electron diffraction apparatus so as to permit the cleaning up of the

surface of a metal specimen in situ. The electron diffraction apparatus contains other original features and is described in some detail. Electrolytically polished single crystals of Cu, Fe and brass have been investigated as well as cleavage faces of Zn. Considerably better electron diffraction patterns are obtained after the sputtering process, owing the the removal of a surface coating deposited during polishing. A Cu surface, which has been cleaned by sputtering, is observed to be quickly covered with a film of Cu_2O when air is admitted to it, but no such film formation is observed in the absence of sputtering. Cleavage surfaces of Zn show only the ZnO pattern; on sputtering for 5 minutes in argon it disappears and is replaced by the Zn pattern. The ZnO film is not pseudomorphic with the Zn structure, as might be expected, in agreement with earlier observations. V.E.Cosslett

539.234 : 535.345 :537.311

4686. THE CONNECTION BETWEEN ELECTRICAL RESISTANCE AND OPTICAL CONSTANTS IN EVAPORATED SILVER FILMS. K.Krebs, H.Nelkowski and R.Winkler.
Z. Phys., Vol. 144, No. 5, 509-20 (1956). In German.

Methods are described for the evaporation of thin silver films and for the production of films of predetermined thickness. A close correlation was observed between the absorption and the resistance of the films. R.A.Weale

539.27

4687. A REPLICA TECHNIQUE FOR "REFLEXION" ELECTRON MICROSCOPY. L.Holland.
Brit. J. appl. Phys., Vol. 7, No. 3, 113 (March, 1956).

The preparation of electro-deposited replicas from a plastic base is more satisfactory if the plasticizer is removed by washing in a detergent prior to metallic evaporation. J.Thewlis

539.27

4688. OBSERVATION OF URANIUM IN THE THERMIONIC EMISSION MICROSCOPE. M.Sternberg.
C.R. Acad. Sci. (Paris), Vol. 242, No. 10, 1307-9 (March 5, 1956). In French.

The oxidation of uranium when heated even in a hi[illegible] vacuum normally prevents observation of its surface structure in the thermionic emission microscope. This is overcome by coating the surface with a thin layer of copper, gold, silver or platinium, which is deposited by introducing a salt of one of these metals in the electrolytic polishing bath. Electron emission then occurs at temperatures of 800°C and upwards, and the crystal structure of the underlying uranium is revealed. The protective metal layer deteriorates after repeated temperature cycling. A.E.I. Research Laboratory

539.27

4689. A METHOD OF OBSERVING URANIUM IN THE PHOTOEMISSION ELECTRON MICROSCOPE. E.L.Huguenin and M.Gauzit.
C.R. Acad. Sci. (Paris), Vol. 242, No. 10, 1309-11 (March 5, 1956). In French.

A uranium surface cannot be prepared clean enough to give satisfactory electron emission within the photoemission microscope. This is overcome by coating the surface with silver during the electropolishing operation, by using a bath which has previously been used for polishing silver. The silver layer is removed within the microscope by bombarding it with 10 kV ions, and the photoemissivity of the underlying uranium is then sufficient for photographs to be obtained in the short time the surface remains clean. A.E.I. Research Laboratory

539.27

4690. TECHNIQUE FOR MAKING SURFACE REPLICAS FROM COMPARATIVELY SMALL OBJECTS. I-M.Feng.
J. appl. Phys., Vol. 27, No. 5, 472-4 (May, 1956).

A simple technique is described and illustrated with electron micrographs taken from replicas prepared by these techniques from glass fibres of 8 μ dia. and 36 grit Al_2O_3 grains. A.

539.27 : 539.23

4691. AN ELECTRON DIFFRACTION EXAMINATION OF THIN FILMS OF ALUMINIUM AND GOLD PREPARED BY VACUUM EVAPORATION. T.B.Rymer.
Proc. Roy. Soc. A, Vol. 235, 274-88 (April 24, 1956).

Thin films of aluminium and gold prepared by vacuum evaporation have been examined by electron diffraction, and accurate measurements made of the interplanar spacings. Th results can be interpreted either (a) by assuming the crystals to be in the form of disks parallel to (111) planes and subject to a homogeneous stress which is predominatly a tension parallel to the [111] direction, or (b) by assuming the crystal to be large and to contain a sessile dislocation. The latter interpretation is preferred. It implies that in the majority of the crystals there is an extra (111) sheet of atoms extending over about 10% of the crystal. A

ELASTICITY. STRENGTH. RHEOLOGY 539.3/.8

539.3

4692. ANALYSIS OF THE GENERALIZED DISTORTION TENSOR. E.Krüner.
Z. Naturforsch., Vol. 11, No. 1, 95-6 (Jan., 1956). In German.

A continuation of earlier work (Abstr. 1654/1956) on the vector analysis of the distortion tensor arising in the theory of elasticity and plasticity. L.S.Godda

539.3

4693. HYPO-ELASTIC SHEAR. C.Truesdell.
J. appl. Phys., Vol. 27, No. 5, 441-8 (May, 1956).

Pt I gives a nonmathematical introduction to the theory hypo-elasticity. Hypo-elasticity is a smooth, simple theory elastic response based on time rates. For small strains it agrees with the classical linear theory of elasticity. To dete mine stress-strain relations for large deformation is a mat matical problem, the answer to which varies from one spec case to another. Simple shear is taken as an example. Here turns out that hypo-elastic materials may soften or stiffen i shear, depending on the value of a dimensionless constant w has no effect when the strain is small. For bodies which sof a theoretical prediction of 'hypo-elastic yield' is obtained. P concerns a new special type of hypo-elastic body in some w more general, in other ways more special than that conside in Pt I. According to this theory, yield of the von Mises typ appears to follow if the stress intensity is sufficiently great The equations of this theory are solved for the case of simp shear. It is shown that if von Mises yield occurs, hypo-elas yield must occur at a lesser stress. For large values of a c tain parameter, von Mises yield is imaginary and only hypo elastic yield occurs. For moderate values of the parameter, hypo-elastic yield appears as primary yield, with von Mise yield as secondary yield at infinite strain. For small values the parameter, hypo-elastic yield and von Mises yield are i distinguishable, and the stress-strain curve is similar to th idealized forms assumed at the outset in the conventional Prandtl–Reuss theory.

539.

4694. ELASTIC CONSTANTS OF THALLIUM ALUM. S.V.Subrahmanyam.
Curr. Sci., Vol. 25, No. 2, 51 (Feb., 1956).

Elastic moduli of thallium alum have been determined using the piezoelectric oscillator method of Balamuth [Phys Rev., Vol. 45, 715 (1934)] and Rose [Phys. Rev., Vol. 49, (1936)]. The frequency range was 100-150 kc/s. The result are $S_{11} = 49.0$, $S_{12} = -15.5$, $S_{44} = 115$: the units are 10^{-13} dyne. cm^{-2}. It is similar to other alums in its elastic behav iour. See Abstr. 1742 (1955). H.G.Jerra

539.32

4695. APPARATUS FOR THE DIRECT DETERMINATION OF THE DYNAMIC BULK MODULUS. J.E.McKinney, H.Edelman and R.S.Marvin.
J. appl. Phys., Vol. 27, No. 5, 425-31 (May, 1956).

An apparatus has been developed for the direct measurement of the real and imaginary parts of the dynamic bulk modulus of solid and liquid materials over the frequency range of 50 to 10 000 c/s. Piezoelectric crystals serving as driver and detector, together with the sample and a confining liquid, are contained in a cavity small compared with the wavelength of sound at these frequencies. Static pressure is superposed to eliminate the effect of small air bubbles. The complex compliances of the sample, confining liquid, and the cavity, are additive in this region, where the compliance is pure dilation. The dynamic compliances of several natural rubber-sulphur mixtures were obtained in a preliminary evaluation of the behaviour of the apparatus. A.

539.32 : 541.183

4696. EFFECT OF GAS ADSORPTION ON THE MODULUS OF RIGIDITY OF A METAL WIRE. A.Clauss.
C.R. Acad. Sci. (Paris), Vol. 242, No. 12, 1578-80 (March 19, 1956). In French.

See also Abstr. 5049 (1954). By using a dynamic (torsional-pendulum) and a static method of investigation, the author found that the modulus of rigidity of an Ag wire (0.06 mm dia.) decreased as the boiling-point of the ambient gas (He, H_2, A, CO_2) increased. The differences between the results obtained by using the two methods are explained. F.Lachman

539.373

4697. INTERSECTION FAULTING MECHANISM THEORY OF FLOW AND FRACTURE OF FACE-CENTERED CUBIC METALS. R.B.Green.
Phys. Rev., Vol. 102, No. 2, 376-80 (April 15, 1956).

The intersection of any dislocation avalanche with a stationary dislocation having a Burgers vector component normal to the slip plane is shown to produce a close-packed partial plane of vacancies or interstitials in the slip plane, intrinsic or extrinsic faults for {111} slip planes. These faults have high energy in non-close-packed planes, consistent with observed slip plane preference. The mechanism gives improved understanding of recent X-ray results. Metallographic slip observations are consistent with the hypothesis that the etch indications are occurring at faults produced by the present mechanism. Fracture is postulated as resulting from the growth of "head-on" faults until transition occurs to the Griffith mechanism. Fault correction by partial slip produces additional dislocations, some potentially active as Frank–Read sources in the other slip planes. For copper, intrinsic or extrinsic faults are estimated to have energies of 40 ergs. cm^{-2} and maximum widths of 400 A. A.

539.374

4698. EXPERIMENTS ON VISCOELASTICITY. D.G.Ivey.
Amer. J. Phys., Vol. 24, No. 5, 373-5 (May, 1956).

The propagation of sound waves in rubber strips is used to illustrate viscoelastic behaviour. The experiments introduce time-dependent mechanical properties of solids at a level suitable for use in undergraduate laboratories. A.

539.374

4699. ANALOGUE STUDY OF COLUMNS OF VARIABLE SECTION IN THE ELASTOPLASTIC STATE WITH THE HELP OF ELECTRICAL RESISTANCE MODELS. R.Scanlan.
C.R. Acad. Sci. (Paris), Vol. 242, No. 9, 1123-5 (Feb. 27, 1956). In French.

Critical loads for buckling can be predicted satisfactorily by setting up a certain electrical network and following a procedure similar to that described previously for the case of an elastic column of variable section [C.R. Acad. Sci. (Paris), Vol. 238, 1470 (1954); Vol. 240, 1047 (1955)]. The resistances in the electrical analogue are related to the constants of the cross-section at a series of positions along the column and to the appropriate slopes of the stress–strain curve, corresponding to local stresses which are beyond the elastic limit. Possible modes of buckling are found by making adjustments to the resistances in an iterative process which is found to converge. J.G.Oldroyd

539.374

4700. STRESS-STRAIN RELATIONS IN SNOW UNDER UNIAXIAL COMPRESSION. J.K.Landauer.
J. appl. Phys., Vol. 26, No. 12, 1493-7 (Dec., 1955).

Two types of tests were performed on the uniaxial compression of snow; experiments at constant strain rate and at constant load. The strain rate can be represented as the product of functions of density, stress, temperature, and time. For densities between $\gamma \cong 0.3$ g/cm^3 and $\gamma \cong 0.6$ g/cm^3 the strain rate is proportional to $(\gamma_{ice} - \gamma)/\gamma$ to the fourth power. The strain rate varies linearly with stress for low stresses ($2 < \sigma < 100$ g/cm^2) but increases to an approximately cubic relationship at higher stresses ($1 < \sigma < 5$ kg/cm^2). An activation energy of about 14 000 cal/mole can be derived from the temperature dependence. In the constant load tests the strain is proportional to the time to a power of about 0.8. The effect of snow type is small, being less than the relatively large experimental scatter encountered. A.

539.374

4701. CALCULATION OF THE COMPLEX MODULUS OF LINEAR VISCOELASTIC MATERIALS FROM VIBRATING REED MEASUREMENTS. D.R.Bland and E.H.Lee.
J. appl. Phys., Vol. 26, No. 12, 1497-503 (Dec., 1955).

Two methods of determining the variation of real and complex modulus with frequency from vibrating reed test results are detailed. One is based on measurements of the relative amplitude and phase lag of the motion of the free and driven ends of the reed, the other on amplitude resonance measurements only. The analysis is based on a general linear viscoelastic law, and takes into account the influence of the frequency dependent moduli of the material on the frequency and amplitude of the resonance peaks. This influence has not been correctly accounted for in previous analyses which have included the assumption that the material behaves according to a particular, simple viscoelastic law, which will in general not be borne out by the final results. The method is applied to a series of tests. For the material and frequency range used the imaginary part of the complex modulus was small compared with the real part, and the influence mentioned in the foregoing was small. A simpler method of analysis might thus be justified, but in other cases it will be necessary to carry out the complete analysis in order to obtain a satisfactory interpretation of test results. A.

539.374

4702. FRACTURE IN THE EXTRUSION OF AMORPHOUS POLYMERS THROUGH CAPILLARIES. J.P.Tordella.
J. appl. Phys., Vol. 27, No. 5, 454-9 (May, 1956).

In the extrusion of an amorphous, un-cross-linked polymer through a capillary, there is a critical stress at and beyond which the emerging stream becomes irregular in shape. This effect appears to originate in the approach to the capillary rather than within the capillary. Tearing or fracture of the molten polymer appears to occur in this region. A.

539.374

4703. THEORY OF DEFORMATION OF POROUS VISCOELASTIC ANISTROPIC SOLID. M.A.Biot.
J. appl. Phys., Vol. 27, No. 5, 459-68 (May, 1956).

Equations are established for the deformation of a viscoelastic porous solid containing a viscous fluid under the most general assumptions of anistropy. The particular cases of transverse and complete isotropy are discussed. General solutions are also developed for the equations in the isotropic case. As an example the problem of the settlement of a loaded column is treated. The second-order effect of the change of permeability with deformation is also discussed. A.

539.374

4704. THE PLASTIC FLOW LAW FOR POLYCRYSTALLINE METALS. U.Dehlinger, J.Diehl and J.Meissner.
Z. Naturforsch., Vol. 11a, No. 1, 37-41 (1956). In German.

General linear equations are stated for the rate of plastic flow and the stress–strain relationship. Prager's increment theory (Abstr. 3475/1948), assuming isotropic strain-hardening, is substantiated by torsion–tension tests (up to 9% elongation) on annealed aluminium. This is contrasted with the behaviour of α-brass which exhibits strain-hardening anisotropy.

A.Gelbtuch

539.4.016.3

4705. AGING PROCESS IN QUENCHED ALUMINIUM–ZINC SOLID SOLUTIONS. K.Hirano.
J. Phys. Soc. Japan, Vol. 10, No. 11, 995-1002 (Nov., 1955).

This has been studied in the same manner as in the Al–Ag system. Specific-heat v. temperature curves have been obtained on the alloys after various ageing treatments. Isothermal ageing curves of electrical resistance have been also examined. In accordance with previous work, the present results reveal that the two reactions take place independently during the ageing; they may be attributed respectively to the formation of the Guinier-Preston zone and the precipitation of the new phase. A.

539.431

4706. AN APPARATUS FOR TESTING METALS TO FAILURE UNDER AN ALTERNATING HIGH-FREQUENCY STRESS. G.Vidal, F.Girard and P.Lanusse.
C.R. Acad. Sci. (Paris), Vol. 242, No. 8, 986-8 (Feb. 20, 1956). In French.

The specimen is mounted on a large immobile mass, being connected to this by a metal tube. A strain gauge is attached to the tube, and the output from this is fed into an amplifier. The amplifier output drives the top of the specimen electromagnetically. The whole system is therefore resonant at the fundamental frequency of the specimen; this is about 6 kc/s for the specimens used. A.J.Kennedy

539.534 : 548.7

4707. POLYGONIZATION IN COPPER. A.Franks and D. McLean.
Phil. Mag (Ser. 8), Vol. 1, 101-2 (Jan., 1956).

X-ray diffraction patterns show that Cu polygonizes during creep at 400° C, but about 100 times slower than Al at 200° C (the "equivalent" temperature if the melting-point ratio is applied). The difference cannot be accounted for, if previously calculated jog energies are used, simply by the difference in the number of jogs present in thermal equilibrium. It is therefore necessary to assume that the number of jogs produced in the Cu by the deformation is $1/100^{th}$ of the number present in the Al. A.J.Kennedy

539.62 : 539.37

4708. THE FRICTION AND DEFORMATION OF POLYMER M.W.Pascoe and D.Tabor.
Proc. Roy. Soc. A, Vol. 235, 210-24 (April 24, 1956).

Earlier work has suggested that the friction of polymers may be explained in terms of the adhesion mechanism originally developed for metals. The present paper confirms this view, but shows that the detailed behaviour differs from that of metals in two main ways. First, in marked contrast to metals, there appears to be little or no junction growth during sliding so that the area of junctions sheared is essentially the same as the area of contact formed under static loading conditions. Secondly, a study of the static indentation properties of polymers on a large scale shows that the deformation is neither purely elastic nor purely plastic but intermediate over a very wide range. The deformation behaviour may be expressed by a single law which may be extrapolated back to predict the area of deformation between crossed fibres at very small loads from deformation experiments carried out on large specimens at very heavy loads. Friction experiments between crossed fibres of circular section show that the friction is directly proportional to the area of deformation so deduced; this suggests that contact occurs at very few asperities, perhaps only one, so that the area of true contact is essentially the same as the area of deformation. This provides a satisfactory explanation of the observed dependence of friction on load and on fibre diameter. At heavy loads on bulk polymer the friction varies less markedly with load, presumably because there is multiple-point contact. Although a number of simplifications are involved, the work provides an effective physical picture of the frictional properties of polymers in terms of their deformation characteristics, assuming the formation of strong interfacial junctions at the regions of real contact. Reasonably good frictional correlation is obtained for a load range of 10^{10} to 1 and for surfaces differing in radius of curvature by a factor of more than 300 to 1. A

PHYSICAL CHEMISTRY 541

PHASE EQUILIBRIUM. CHEMICAL REACTIONS 541.11/.12

541.124/.128

4709. KINETICS AND MECHANISM OF REACTIONS OF NUCLEOPHILIC SUBSTITUTIONS. M.Simonetta.
Nuovo Cimento Suppl. (Ser. 10), Vol. 2, No. 4, 969-82 (1955). In Italian.

Nucleophilic substitutions are defined by the formula

$$Y: + R|:X \rightarrow Y:R + X:$$

i.e. they are asymmetric substitutions in which the substituent group uses its valency electrons for attaching itself to the core of the radical. Their reaction mechanism is investigated for aliphatic and aromatic compounds and for an intermediate case, namely the side chains of benzene derivatives in ortho-, meta- and para-configurations. A distinction is made between bimolecular and monomolecular mechanisms, the former proceeding in a single and the latter in two stages, with low or high reaction speed. Reference is made to previous work of Wheland and Pauling, Ingold, Hughes and Dostrowsky, Robert Hammett, Jaffé and Gotowski. R.Neumann

541.12

4710. ANOMALY IN CHEMICAL REACTIVITY OF CERTAIN ALLOYS AT THE CURIE POINT OF THE PURE MAGNETIC METAL. H.Forestier and G.Nury.
C.R. Acad. Sci. (Paris), Vol. 242, No. 10, 1297-9 (March 5, 1956). In French.

The nitruration and cementation (formation of hard nitrid and carbide) of the homogeneous ferromagnetic alloys 71 Fe–29 Ni, 50 Ni–50 Cu, and 75 Fe–25 Cr has been studied as a function of temperature by following changes in the surface hardness. In each case a sharp maximum in reactivity was observed at the Curie point of the pure ferromagnetic component (the FeNi alloy was not studied up to the Fe Curie point but showed a sharp increase at the Ni Curie point). No physical transformations could be detected at these temperatures by thermomagnetic or dilatometric means; in particular, magnetic susceptibility measurements demonstrated the

absence of free Fe or Ni. These results are in agreement with previous work on NiCo alloys. A.B.Lidiard

541.124

4711. HOMOGENEOUS EXCHANGE REACTION BETWEEN HYDROGEN AND DEUTERIUM. G.Boato, G.Careri, A.Cimino, E.Molinari and G.G.Volpi.
J. chem. Phys., Vol. 24, No. 4, 783-91 (April, 1956).

This has been reinvestigated, to see whether a more satisfactory quantitative test of the transition state method could be obtained in this simple chemical reaction. The reaction was studied in the temperature range from 916°K to 1010°K, where the heterogeneous contribution from the walls was found to be negligible. Preventing air from diffusing into the reaction vessel through the walls, exchange rates lower by a factor of 2.0 than those obtained by previous authors were found in the whole temperature interval. The total activation energy was determined as 59.8 ± 0.4 kcal/mole. The validity of the transition state method was tested by extrapolation of the experimental data to a lower temperature region (283°-373°K) where independent experimental data were available. Comparison of the extrapolated values with the experimental ones leads to a very good agreement. A.

541.124

4712. ELECTROSTATIC FREE ENERGY AND OTHER PROPERTIES OF STATES HAVING NONEQUILIBRIUM POLARIZATION. R.A.Marcus.
J. chem. Phys., Vol. 24, No. 5, 979-89 (May, 1956).

Various processes such as electron transfer reactions, redox reactions at electrodes, and electronic excitation of dissolved ions may proceed by way of intermediate states whose electrical polarization is not in equilibrium with the field arising from the charges present. The usual expressions for the electrostatic free energy and for the differential equation satisfied by the potential assume that the polarization and the field are in equilibrium. Accordingly, these equations are of but limited applicability to these processes. In the present paper equations are derived for various properties of systems having such nonequilibrium electrostatic configurations. These properties include the free energy, energy, and entropy of the nonequilibrium system, and the spacial dependence of the electrostatic potential. The free energy, for example, is used to calculate the probability of formation of nonequilibrium states in certain problems of physical interest. A.

541.124

4713. CHEMICAL REACTIONS WITH WHITE AND GRAY TIN. T.Gela.
J. chem. Phys., Vol.24, No. 5, 1009-11 (May, 1956).

Each of the two polymorphic forms of pure tin were found to produce different chemical compounds when reacted with concentrated hydrochloric acid under identical conditions. These findings were established by X-ray diffraction and chemical analysis. The metallic form of β white tin combined as Sn^{++}, whereas the semiconducting form of α gray tin combined as Sn^{++++}. This chemical behaviour was found to be consistent with the electronic configuration of the valence electrons ascribed to each form of the tin atom. A.

541.124 : 530.162

THE DIFFUSION THEORY OF CHEMICAL REACTIONS. See Abstr. 3508

541.126 : 536.46

4714. PHOTOMETRIC INVESTIGATIONS OF ALKALI METALS IN HYDROGEN FLAME GASES. II. THE STUDY OF EXCESS CONCENTRATIONS OF HYDROGEN ATOMS IN BURNT GAS MIXTURES. E.M.Bulewicz, C.G.James and T.M.Sugden.
Proc. Roy. Soc. A, Vol. 235, 89-106 (April 10, 1956).

For Pt I, see Abstr. 1762 (1955). Photometric measurements on alkali metals in hydrogen-oxygen flame gases, diluted with various proportions of nitrogen, are interpreted as giving a measure of the concentration of free hydrogen atoms, which persist in these gases for several milliseconds after primary combustion. These concentrations are well in excess of those expected from thermodynamic equilibrium, especially towards the lower end of the range of temperatures studied (2400 to 1600°K). Two kinds of measurement have been made. (i) Comparison of the intensities of the Na D lines and the Li resonance doublets, for equal traces of the two elements present in the gases. The amount of free lithium is modified by the balanced processes, $Li + H_2O \rightleftharpoons LiOH + H$, whereas corresponding reactions for sodium are negligible. Using estimated equilibrium constants for these reactions, [H] can be obtained. (ii) Measurements of the change in intensity of the Na D lines when 0.01 to 0.5% of chlorine or its compounds (a large excess over the sodium) are added to the flame gases. NaCl is considered to be formed by the balanced reactions $Na + HCl \rightleftharpoons NaCl + H$. The concentration of HCl, the most important chlorine compound in the hydrogen-rich flame gases, may be obtained from the total chlorine added. Using estimated equilibrium constants for the above reaction, [H] can again be obtained. The agreement between the [H] values obtained by these two independent methods is good. The decrease of [H] with height in the gases is consistent with ternary recombination towards full equilibrium. A general discussion of excess radical concentrations in hydrogen flame gases is given, for hydroxyl radicals and oxygen atoms as well as hydrogen atoms. The conclusions reached are supported by experimental evidence. A further discussion of the way in which the amounts of chlorine used in the experiments may affect the other radical concentrations is given. A.

541.126 : 536.71

4715. CALCULATION OF THE DETONATION PROPERTIES OF SOLID EXPLOSIVES WITH THE KISTIAKOWSKY-WILSON EQUATION OF STATE. R.D.Cowan and W.Fickett.
J. chem. Phys., Vol. 24, No. 5, 932-9 (May, 1956).

The Kistiakowsky-Wilson equation of state, $pV_g = RT(1 + xe^{\beta x})$, where $x = k/V_g(T + \theta)^{\alpha}$, for the gaseous detonation products of solid explosives has been re-examined in the light of new experimental data on detonation pressure and on the variation of detonation velocity D with loading density ρ_0 for several RDX/TNT mixtures. The value $\beta = 0.30$ used in the past is too high to match the observed slopes of the $D - \rho_0$ curves. The old value $\alpha = 0.25$ is too small to match the experimental Chapman-Jouguet pressure of most of these explosives, but too large to match the pressure of pure TNT. A suitable compromise for the explosives considered is $\alpha = 0.5$, $\beta = 0.09$, $\theta = 400°K$. A.

541.127.1

4716. DETONATION OF NITROMETHANE. G.Nahmani and Y.Manheimer.
J. chem. Phys., Vol. 24, No. 5, 1074-7 (May, 1956).

The detonation velocity of nitromethane has been measured for various charge radii and confining materials. A critical diameter of 27 mm for the detonation of unconfined nitromethane has been found. Estimates of the energy of activation, the length of the reaction zone and the reaction time are obtained, according to Eyring's theory. A.

ELECTROCHEMISTRY 541.13

541.132

4717. ZINC AND CADMIUM CHLORIDE COMPLEXES IN MOLTEN SALTS. M.A.Bredig and E.R.Van Artsdalen.
J. chem. Phys., Vol. 24, No. 2, 478-9 (Feb., 1956).

Recent freezing point depression measurements (to be published) have led to the conclusion that $CdCl_3^-$ is an unimportant, $CdCl_4^{2-}$ an important species in molten $CdCl_2$-$NaNO_3$-

KCl mixtures. It is pointed out that the substitution of $CdCl_4^{2-}$ ions for $CdCl_3^-$ ions is just as feasible in the interpretation of Raman spectra, electrical conductivity, surface tension and viscosity data. W.Good

541.135 : 539.155.2

4718. TEMPERATURE DEPENDENCE OF THE ISOTOPE EFFECT ON THE PASSAGE OF ELECTRIC CURRENT THROUGH MOLTEN In. A.Lodding, A.Lunden and H.von Ubisch.
Z. Naturforsch., Vol. 11a, No. 2, 139-42 (1956). In German.

See also Abstr. 3772, 10433 (1954) and 7462 (1955). When d.c. was passed through capillary tubes filled with molten In, the cathode portion was enriched in In^{115}, and the anode portion in In^{113}. This effect was measured at temperatures in the range 210-830° C (and in solidified In at 123° C), and was found to be a function of temperature, the increase of the mass effect with temperature being of the same order of magnitude as the theoretically obtained value. F.Lachman

541.135.5

4719. THE MECHANISM OF THE FORMATION OF ANODE LAYERS IN DIELECTRICS DURING THE FORMATION PROCESS. Ya.N.Pershits.
Zh. éksper. teor. Fiz., Vol. 29, No. 3(9), 362-7 (1955). In Russian.

The character of the phenomena near the electrode was found to be the same for all dielectrics investigated and cannot be explained by mere uncompensated cation movements. Anions must definitely take part in these processes. The assumption is that oxygen evolved at the anode in electrolytic processes during cation displacements makes an important contribution to the formation of the anode layer. In this respect the purely ionic conductivity of glass is interesting.
Electrical Research Association

541.135.5

4720. A METHOD FOR THE STUDY OF FAST ELECTRODE REACTIONS. T.Berzins and P.Delahay.
Z. Elektrochem., Vol. 59, No. 7-8, 792-7 (1955). In German.

The method consists in applying a current pulse in the form of a simple step to the electrolytic cell consisting either of two similar polarizable electrodes, or one polarizable and the other unpolarizable, and enables rate constants up to 10^3 cm.sec^{-1} to be determined. Electrolysis with square-form and with sinusoidal alternating current are theoretically treated. W.Good

541.135.5 : 539.16.08

4721. INVESTIGATIONS ON THE HETEROGENEITY OF ELECTRODE SURFACES WITH RADIOACTIVE INDICATORS. M.Haissinsky.
Z. Elektrochem., Vol. 59, No. 7-8, 750-1 (1955). In German.

The influence of concentration and the condition of the electrode surface on the deposition potential, the quantity deposited as a function of the electrode potential, the distribution equilibrium at constant potential between the solution and the electrode, the microheterogeneity of the surface as shown by radiographs, and the effect of previous cathodic polarization of the electrode have been studied in the dilution range 10^{-3} to 10^{-16} molar, for the deposition of radioactive polonium, bismuth, lead, protoactinium, ruthenium and tellurium on An, Pt, Pd, Ag, Ni, Ta, Pb and W. W.Good

PHOTOCHEMISTRY. RADIATION CHEMISTRY 541.14/.15

541.14

4722. VACUUM ULTRAVIOLET PHOTOCHEMISTRY. III. ACETYLENE AT 1849 A. M.Zelikoff and L.M.Aschenbrand.
J. chem. Phys., Vol. 24, No. 5, 1034-7 (May, 1956).

For Pt II see Abstr. 595 (1955). The products of acetylene photolysis at 1849 A were found to be a polymer resembling cuprene, hydrogen, ethylene, diacetylene, vinylacetylene, and benzene. The relationships of the quantum yields of these products to pressure of acetylene suggest that both free radicals and excited acetylene molecules are involved in the photolytic mechanism. This suggestion is strongly supported by the natur of the absorption spectrum, since in this wavelength region, the absorption is partly discrete and partly continuous. A.

541.14

4723. PHOTODECOMPOSITION OF FORMALDEHYDE; STABILITY OF THE HCO RADICAL. R.Klein and L.J.Schoen.
J. chem. Phys., Vol. 24, No. 5, 1094-6 (May, 1956).

Observations on the photodecomposition of mixtures of normal and deuterated formaldehydes give reliable data for calculating the stability of the HCO radical. The relative occur rence of the intramolecular split and the H-atom dissociation reaction in the primary photochemical act is determined by the deviation of the apparent equilibrium constant for the hydr gen isotope product species from the actual constant. It is shown that a wavelength of 3650 A is effective for breaking the first CH bond in formaldehyde, and this leads to 27 kcal as a lower value for the heat of dissociation of HCO to H and CO. The intramolecular split reaction occurs not only at 3650 A, but also at 3130 A, and is an important if not the major prima photochemical process. A

541.15

4724. ACTION OF γ-RAYS ON POLYMERS IN THE SOLID STATE. II. DEGRADATION OF METHYL METHACRYLATE AND OF CELLULOSE ACETATE. A.Chapiro.
J. Chim. phys., Vol. 53, No. 3, 295-305 (March, 1956). In French.

The methods described in Pt I (Abstr. 7468/1955), in whic the effect of radiation on the temperature at which a specimen under stress flows or ruptures is measured, are applied to Plexiglas (methyl methacrylate) and Rhodoid (cellulose acetate) In both cases there is a progressive decrease of the "fusion temperature" with dose, and in the case of Plexiglas this is followed by an "after-effect", probably due to degradation, observed at the lower dosage rates. There is a change of colour during the irradiation and the corresponding changes in absorption spectrum include two independent processes: a displacement of an ultraviolet band towards the visible and the appearance of a new band at 5050 A. The latter disappears slowly at 20° C and more rapidly at 80° A. The various chemica mechanisms which could explain these effects and account for degradation of the polymers are discussed. C.B.Allsopp

541.15

4725. THE MECHANISM OF RADIATION CHEMICAL DEGRADATION OF POLYMERS. A.Chapiro.
J. Chim. phys., Vol. 53, No. 3, 306-7 (March, 1956). In French.

Data published by Alexander, Black and Charlesby (Abstr. 10038/1955) on the degradation of polyisobutylene by ionizing radiation have been reinterpreted on the basis of the hypothesi presented by A.Chapiro (preceding abstract). It is suggested that several breaks can originate from one quaternary carbon atom after only one primary radiation chemical act. These breaks can give rise to a number of different radicals; which, in their turn, can produce new breaks, double bonds, methane and hydrogen. A temperature dependence can be predicted. M.Ebert

541.15 : 539.27

4726. DECOMPOSITION OF $CaSO_4.2H_2O$ IN THE ELECTRON MICROSCOPE. J.H.Talbot.
Brit. J. appl. Phys., Vol. 7, No. 3, 110-13 (March, 1956).

From examination by electron diffraction it is shown that $CaSO_4.2H_2O$ transforms to anhydrous $CaSO_4$ when placed in the electron microscope and that it is decomposed into CaS and CaO by intense electron bombardment. J.Thewlis

DISPERSIONS. COLLOIDS. ADSORPTION 541.18

541.18.043

4727. EFFECTS OF A CONCENTRATION DEPENDENCE OF THE SEDIMENTATION COEFFICIENT IN VELOCITY ULTRACENTRIFUGATION. H.Fujita.
J. chem. Phys., Vol.24, No. 5, 1084-90 (May, 1956).

The Lamm differential equation for the sedimentation process in the ultracentrifuge is solved in closed form for the case in which the sedimentation coefficient, s, decreases linearly with the concentration, C, by employing the assumption which was adopted originally by Faxén who considered a similar problem with s independent of C. It is shown that, with increasing concentration dependence of s, the concentration gradient curve is markedly sharpened, and the whole curve is also noticeably shifted towards the solvent side, but symmetry of the curve is practically maintained except at the edges. A simple and approximate equation which predicts the position of the maximum of a given boundary curve as a function of time for a given set of the parameters is derived. It is shown that this equation is useful for evaluating the sedimentation coefficient at a given concentration. An equation which also predicts the maximum height of the boundary curve as functions of time and related parameters with a satisfactory degree of approximation is obtained. Using this equation, reliable values of the diffusion coefficient may be obtained from sedimentation experiments when s depends linearly on C. A.

541.183

4728. USE OF INTERPOLATION THEORY IN THE ANALYSIS OF GAS ADSORPTION ISOTHERMS. III. APPLICATION TO LOW-TEMPERATURE DATA. J.M.Honig.
J. chem. Phys., Vol. 24, No. 3, 510-13 (March, 1956).

For Pt II see Abstr. 770 (1956). To furnish a concrete illustration of the interpolation method, the adsorption of helium on charcoal and of neon on glass in the liquid hydrogen temperature range is analyzed by this theory. The interpolation method yields results which are consistent with information on the adsorption data available from other sources. A.

541.183

4729. ADSORPTION STUDIES ON CLAY MINERALS. VI. ALKALI IONS ON ATTAPULGITE. C.N.Merriam, Jr and H.C.Thomas.
J. chem. Phys., Vol. 24, No. 5, 993-5 (May, 1956).

For Pt V, see Abstr. 1711 (1956). The exchange equilibria of the alkali ions Cs, K, Na, Li on attapulgite have been studied at 30° and 75°. Thermodynamic data for the systems have been calculated. Caesium is the most strongly adsorbed ion and the others follow in the order given. The specificity of the clay becomes lower at the higher temperature. A.

541.183 : 541.138

4730. ADSORPTION PHENOMENA AND ELECTROCHEMICAL KINETICS. A.Frumkin.
Z. Elektrochem., Vol. 59, No. 7-8, 807-22 (1955). In German.

A review lecture and discussion. W.Good

CHEMICAL STRUCTURE 541.2/.6

541.51

4731. ELECTRON AFFINITIES, METHYL AFFINITIES, AND IONIZATION ENERGIES OF CONDENSED RING AROMATIC HYDROCARBONS. F.A.Matsen.
J. chem. Phys., Vol. 24, No. 3, 602-6 (March, 1956).

The electron affinities of condensed ring aromatic molecules are calculated from half-wave-reduction potentials and the absolute potential of the normal calomel electrode. The results correlate with molecular orbital theory and frequency of absorption and extrapolate to the work function of graphite. A parallel correlation is made for the ionization energies. A correlation is also shown to exist between the electron affinity and the methyl affinity defined by Szwarc. Finally the results are discussed in terms of the approximate self-consistent field theory of Pople, from which it is possible to make an a priori estimate of the work function of graphite. A.

CHEMICAL ANALYSIS 543/545

545.72

4732. TWO DESIGNS FOR A PARAMAGNETIC OXYGEN METER. A.Hobson and R.H.Kay.
J. sci. Instrum., Vol. 33, No. 5, 176-81 (May, 1956).

A robust oxygen detector capable of giving direct readings on a meter or recorder has many applications in physiology or in the control of chemical processes. Physical methods at present available commercially have characteristics which often make them unsuitable for particular applications. This paper describes two separate but parallel investigations of the design of an oxygen meter depending on the paramagnetism of oxygen and the change of its susceptibility with temperature. One instrument covers 0-100% oxygen concentrations at or near atmospheric pressure, the other 90-170 mm of mercury partial pressure of oxygen in total ambient pressures of about 600-900 mm of mercury. A.

CRYSTALLOGRAPHY 548

548.5

4733. "PSEUDO-MONOCRYSTALS" OF ALPHA-TITANIUM. H.Leidheiser, Jr and F.J.Denise.
J. chem. Phys., Vol. 24, No. 3, 625-6 (March, 1956).

Describes preparation and properties of very highly oriented samples of α-Ti, (2 x 1/2 in.), apparently derived from single crystals of β-Ti formed at high temperature. J.Hawgood

548.5 : 669

GROWTH OF CRYSTALS BY FLOATING ZONE MELTING. See Abstr. 4132

ATOMIC AND X-RAY CRYSTALLOGRAPHY 548.7

548.7

4734. ANNEALING OF IRRADIATION EFFECTS IN SODIUM CHLORIDE IRRADIATED WITH HIGH-ENERGY PROTONS. K.Kobayashi.
Phys. Rev., Vol. 102, No. 2, 348-55 (April 15, 1956).

Single crystals of sodium chloride were subjected to irradiation at room temperature by 350 MeV protons with a total flux of 10^{12} to 10^{16} protons per cm^2, and changes in their electrical conductivity, stored energy, and optical absorption were studied. The relative resistivity changes due to irradia-

551.510.535

RADIO-WAVE PROPAGATION IN THE IONOSPHERE. See also under "Electromagnetic waves and oscillations". Decimal classification 538.566.3

551.510.535

4749. WAVE SOLUTIONS FOR CRITICAL AND NEAR-CRITICAL COUPLING CONDITIONS IN THE IONOSPHERE. N.Davids and R.W.Parkinson.
J. atmos. terrest. Phys., Vol. 7, No. 4-5, 173-202 (Oct., 1955).

Principal dielectric axis co-ordinates are used to put the coupled wave equations for ionospheric propagation into a form which is suitable for an analysis of critical coupling. This approach removes the singularity formerly associated with critical coupling. The analysis is carried out through the second order and compared with some recent data on polarization. The results compare favourably for several ionospheric models considered. A satisfactory analysis of split echoes at 150 kc/s is developed. A.

551.510.535

4750. THE NIGHT-TIME LOWER IONOSPHERE AS DEDUCED FROM A THEORETICAL AND EXPERIMENTAL INVESTIGATION OF COUPLING PHENOMENA AT 150 kc/sec. R.W.Parkinson.
J. atmos. terrest. Phys., Vol. 7, No. 4-5, 203-34 (Oct., 1955).

Final results of an experimental programme for the investigation of coupling phenomena at 150 kc/s which covered a period of some ten months in all, are presented. Conclusions are obtained, from a comparison of the theoretical results reported in the preceding abstract and the experimental data, regarding the shape of the night-time D-layer in the coupling region and its seasonal and diurnal variations. Sunset D-E region models for July and November 1953 are proposed. A theoretical recombination coefficient model suggested by Mitra (1954) is then applied in the usual manner to determine the variation of these models with time of night. Finally, comparison is made both with the conclusions obtained from the data on coupling phenomena and with all other available low-frequency data; very good agreement is obtained in all cases. It is concluded that the theoretical analysis satisfactorily explains the experimental observations. A.

551.510.535

4751. SOME FEATURES OF THE AUTOMATIC P' -f RECORDS OBTAINED AT IONOSPHERE FIELD STATION, HARINGHATA. A.K.Saha and S.Ray.
Sci. and Culture, Vol. 21, No. 2, 111-13 (Aug., 1955).

P'f records have been taken at Haringhata (22° 56' N, 88° 31' E) since Dec. 1954. Features described include the appearance of an E2-trace in daytime, night-time scatter and the occurrence of an unusual double F-trace generally in the middle of the night. G.M.Brown

551.521.3 : 551.463

4752. APPLICATION OF THE METHOD OF CHANDRASEKHAR TO THE STUDY OF RADIATION SCATTERED IN MIST AND IN THE SEA. J.Lenoble.
Rev. Opt., Vol. 35, No. 1, 1-17 (Jan., 1956). In French.

The method is used to calculate the illumination (1) in the sea, for a uniform sky and for the sun at 59° from the zenith, assuming the absorption coefficient to be half the scattering coefficient; and (2) below a mist of large drops, there being no absorption and a uniform sky. The results are given as curves of illumination as a function of angle and depth. G.F.Lothian

551.521.6 : 551.524.7

4753. INTERFERENTIAL STUDY OF THE RADIATION FROM ATOMIC OXYGEN IN THE UPPER ATMOSPHERE. J.Cabannes and J.Dufay.
Rev. Opt., Vol. 35, No. 2, 103-12 (Feb., 1956). In French.

Using a 5 cm ZnS + cryolith multilayer Fabry–Perot etalon wavelengths of the red O I lines at 6300 A and 6364 A have been determined photographically. Mean results from 12 observations are 6300.308 ± 0.004 A, and 6363.790 ± 0.0045 A. A provisional estimate of the upper atmospheric temperature at the level of emission is derived from measures of ring-width at a high order of interference and found to be less than 700°K. D.R.Barber

551.521.6

4754. INFRARED RADIATION IN THE ATMOSPHERE. G.N.Plass.
Amer. J. Phys., Vol. 24, No. 5, 303-21 (May, 1956).

The infrared radiation flux in the atmosphere is determined by the distribution of three gases — water vapour, carbon dioxide, and ozone. The general equations for the transfer of radiation in gas are derived. These equations are solved for four simple model atmospheres that illustrate various features of the more complicated results for the earth's atmosphere. The atmospheric infrared radiation flux can be calculated from laboratory absorption measurements. The results of such calculations are discussed in detail for the frequency ranges that are influenced by the carbon dioxide and ozone bands.

551.59 : 551.510.

4755. EFFECT OF CARBON DIOXIDE VARIATIONS ON CLIMATE. G.N.Plass.
Amer. J. Phys., Vol. 24, No. 5, 376-87 (May, 1956).

Variations in the amount of atmospheric carbon dioxide cause temperature changes sufficiently large to influence the climate. If the atmospheric carbon dioxide doubles, the surface temperature rises 3.6°C; if it is cut in half, the surface temperature falls 3.8°C. Some of the factors that can be explained by the carbon dioxide theory are: during a single glacial epoch, the climate continually oscillates between a glacial and an interglacial stage with a period of tens of thousands of years with no stable state possible, when the carbon dioxide amount is below a certain critical value, the increased precipitation at the beginning of a glacial period; the time lag between the period of mountain building and the onset of glaciation; periods of glaciation occur at the same time in both hemispheres; the general warming of the climate in the last fifty years. The various factors that enter into the carbon dioxide balance and the influence of the oceans on the atmospheric carbon dioxide amount are discussed in detail. In contrast to other theories of climatic change, the carbon dioxide theory predicts a warming trend that will continue for centuries or as long as fossil fuels are burned in significant quantities.

551.593.

4756. INVESTIGATIONS ON THE HEIGHT OF THE LUMINESCENT LAYER. G.K.Guirguis and A.Hammad.
Proc. Egypt. Acad. Sci., Vol. 9, 1-9 (1953; publ. 1954).

Radiation-field theory is applied to a discussion of the validity of the original Van Rhijn (1924) formula and subsequent modifications (Barbier and Dufay, 1944 : 1947 : 1951), as a basis for computing the heights of the several atmospheric emissions. The assumption of a constant value of J(r) for an atmosphere of finite optical thickness appears valid, except that the actual value of J(r) needs to be modified, particularly when the altitude of the emitting layer is low. D.R.Barber

551.594.

4757. RADIOACTIVE NUCLEI IN RAINS OVER CALCUTTA. K.G.Bandopadhyay, G.C.Ghosh, P.Bandopadhyay, J.C.Chakravarti and S.D.Chatterjee.
Sci. and Culture, Vol. 21, No. 5, 273-5 (Nov., 1955).

The existence of several long-life fusion nuclei has been examined at Calcutta by collection of rain water over the two periods March-June and July-Sept., 1955. Wind-blown dust was separated by a Whatman filter-paper. In a preliminary

ɔte on the results the analysis shows the preponderance of -activity while α- and γ-activities were verified. Energy ınge measurements of various particles were made.

R.S.Read

551.594.51

758. MEASUREMENTS OF THE MEAN LIFETIME OF THE IETASTABLE ^{1}S-STATE OF THE OXYGEN ATOM IN THE PPER ATMOSPHERE DURING AURORAL DISPLAYS. .Omholt and L.Harang.

. atmos. terrest. Phys., Vol. 7, No. 4-5, 247-53 (Oct., 1955).

The intensity variations of the green oxygen line 5577 A D-^{1}S) and the first negative nitrogen band 4278 A (N_2^+, $^2\Sigma_u^+ - X^2\Sigma_g^+$) are measured in rapidly changing aurorae. The mean lifetime of the upper state of the nitrogen band is of the order 10^{-8} sec, the intensity variations of this band will probably therefore at the same time represent the instantaneous relative excitation rate of the metastable OI ^{1}S-level. The mean lifetime of the metastable OI ^{1}S-level is theoretically calculated to be of the order $\tau = 0.75$ sec (Garstang, 1951). One should therefore expect a time-lag in the intensity curve of the 5577-line relative to the 4278-band. This effect is demonstrated on the records, and the mean lifetime of the OI ^{1}S-level is found to vary between 0.45 and 0.75 sec. The upper value (0.75 sec) confirms the theoretical value found by Garstang (1951), the lower value found indicates that a probability of collisional deactivation of the metastable OI ^{1}S-level of the order 1 sec^{-1} may appear in the auroral region of the upper atmosphere. A.

BIOLOGY 57/59

MEDICAL SCIENCE. HUMAN PHYSIOLOGY 61

612.843.613

759. INFLUENCE OF THE ADAPTATIONAL LEVEL OF NE EYE ON THE DIFFERENTIAL THRESHOLD OF THE THER. M.Solis and M.Aguilar.

n. Real Soc. Españ. Fís. Quím., Vol.51(A), No.9-10, 233-6 .955). In Spanish.

The left eye (4 observers) was exposed to luminance vels L varying from 10^{-1} to 10^4 nits. $\Delta L/L$ was measured ith the right eye at various values of L, and was found to be inimal when L was approximately the same for both eyes.

R.A.Weale

612.843.613

760. DIFFERENTIAL THRESHOLDS AND VISUAL ACUITY .T FIXED ADAPTATIONAL LEVELS. J.Oliva and .Baleriola.

n. Real Soc. Españ. Fís. Quím., Vol.51(A), No.11-12, 283-90 1955). In Spanish.

The apparatus is described with which the above quanti- es were measured. ΔL was measured with test field sizes $' \leq d \leq 3^0$. For luminance values L of the adapting field (60°) ying between 0 and 2×10^{-4} nits, summation was complete; ess so at higher levels, particularly when d was less than 20′. xtra-foveal visual acuity, measured at L=O, 3×10^{-2} and $\times 10^{-1}$ nits, showed an accurate inverse proportionality with ccentricity in the range 4-28°. The results are discussed in erms of the activity of horizontal cells. R.A.Weale

615.849

762. A REMOTE CONTROL APPARATUS FOR THE OVEMENT OF DOSAGE MEASURING OR SIMILAR EQUIP- ENT TO INDICATED POSITIONS. B.J.Perry and N.H.Pierce. sci. Instrum., Vol. 33, No. 5, 191-3 (May, 1956).

The mechanical and electrical features of this apparatus e described, with particular reference to ease and cost of construction. The relation of mechanical and electrical backlash to the accuracy of the whole system is discussed, and it is shown that some electrical backlash is essential in this simple type of servo-system. Its relation to position setting backlash and minimum inching distance is indicated. A.

612.858.73

4761. MASKING OF TONAL SIGNALS. L.A.Jeffress, H.C.Blodgett, T.T.Sandel and C.L.Wood, III.

J. Acoust. Soc. Amer., Vol. 28, No. 3, 416-26 (May, 1956).

Many of the phenomena of masking can be explained on the basis of two models, one for monaural listening, and the other for binaural. The monaural model is the familiar narrow band-pass filter followed by a detector responsive to changes in output level. The binaural model is a series of coincidence-detectors associated with a delay-network capable of matching a delay in the stimulus with a delay in the neural path. The two models have proved helpful in understanding the phenomena of tonal masking, and have led to a number of predictions which have been subsequently verified by experiments reported here. Some of the new findings are related to monaural masking and some to binaural. Among the latter are the fact that masking-level differences can be observed in the masking of one pure tone by another when a short signal is employed, and that a binaural signal can be heard in the presence of uncorrelated noise at the two ears better than a monaural signal can be heard against noise presented monaurally, again provided that a short signal is employed. Many studies of the masking of tones have appeared during the past few years. They have been characterized by close agreement in results wherever they have had common conditions, and they provide a large body of dependable quantitative information. With this body of fact there also grew, at least in the minds of present writers, a considerable state of bewilderment. Many of the facts appeared to contradict inferences drawn from others. The present paper discusses a number of these facts and attempts to encompass them under a few explanatory principles. A.

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PHOTOGRAPHY 77

77.023.4

4763. PHOTOGRAPHIC DEVELOPING AS AN ELECTRODE PROCESS. W.Jaenicke and C.Schott.
Z. Elektrochem., Vol. 59, No. 10, 956-67 (1955). In German.

The kinetics of photographic development are interpreted by regarding the latent image as made up of local galvanic elements, Ag/AgBr. The latter become short-circuited in the presence of the developer; the latter is then oxidized at the silver nucleus in the silver bromide grain with the production of more silver from the AgBr and the liberation to the solution of Br^-. This view is experimentally tested on a model in which the anodic (Ag) and cathodic (AgBr) parts are immersed in flowing developer solution and connected externally through a galvanometer. The current is taken as a measure of development velocity and is found to depend on the surface structure of the anode, exit velocity of the halogen ion, concentration of developer, pH value, and the difference between the reduction potential of the developer and the work potential of the silver halide. The results are in general agreement with photographic experience. W.Good

771.534.5

4764. SIMPLE METHODS FOR APPROXIMATING THE FRACTIONAL GRADIENT SPEEDS OF PHOTOGRAPHIC MATERIALS. C.N.Nelson and J.L.Simonds.
J. Opt. Soc. Amer., Vol. 46, No. 5, 324-33 (May, 1956).

The American Standard method for determining the photographic speed of negative materials, and the corresponding British Standard, specify the 0.3 $\bar{G}$ fractional-gradient criterion for measuring speed sensitometrically. This criterion was adopted because it gives speed values which correlate more closely with speeds obtained by picture tests than do the speeds obtained by any other known sensitometric speed criterion. A frequent criticism, however, of the 0.3 $\bar{G}$ criterion is that it is more difficult to operate and more subject to random errors than simpler criteria, such as the one based on a density of 0.1 above fog. In the present paper, two methods of evaluating speed are described which are simple to operate and which give highly repeatable results that agree closely with accurately measured 0.3 $\bar{G}$ speeds and with speeds based on picture tests. The first method utilizes a mathematical representation of a portion of the sensitometric curve and converts inertia speed to an approximation of 0.3 $\bar{G}$ speed by means of a measurement of the length of the toe of the curve. The second method converts the speed based on a density of 0.1 above fog to an approximation of 0.3 $\bar{G}$ speed by means of the density resulting from an exposure equal to twenty times that required for the densit of 0.1 above fog. Both methods are suitable for practical use, but the first method is of particular interest in the mathemati al theory of the shape of the sensitometric curve and its relat ion to speed. The second method is especially suited to rapid, routine determination of speeds and is adaptable to automatic computation of speeds from density measurements without the necessity of drawing the sensitometric curve.

774 : 541.146.

4765. RUSSELL EFFECT IN SILICON AND GERMANIUM. A.J.Ahearn and J.T.Law.
J. chem. Phys., Vol. 24, No. 3, 633-4 (March, 1956).

H_2O_2 formed at abraded metal surfaces produced photographic images; studies with different surfaces, different exposures and at reduced pressure showed that the formation o H_2O_2 persists over many minutes, and that any clean Si surface gives the effect. Rates of image formation from Al, Ge and Si were in the ratio 1 : 20 : 400. J.Hawgoo

778.1

4766. FINE GRAIN DEVELOPMENT IN XEROGRAPHY. K.A.Metcalfe and R.J.Wright.
J. sci. Instrum., Vol. 33, No. 5, 194-5 (May, 1956).

Electrostatic images on xerographic plates may be developed by electrophoretic deposition from simply prepare suspensions of powders in certain high-resistivity liquids. Prior milling of the powders in the liquids or in dispersing agents results in finer-grained developers. Virtually grainle images should be obtainable by development in colloidal suspensions.

778.3

4767. COLOUR AUTORADIOGRAPHY. G.W.Buckaloo and D.V.Cohn.
Science, Vol. 123, 333 (Feb. 24, 1956).

The effect of exposing multilayer colour film to radiatio from radioisotopes should be to produce colours dependent o the ratio of absorption in the layers, i.e. to produce a colour pattern representative of the energy spectrum of the isotope. Results for C^{14}, S^{35}, Ca^{45}, I^{131} and P^{32} are given. The method will differentiate between isotopes provided sufficient difference exists between their energy spectra. D.V.Mabb

778.34 : 537.591

SPURIOUS SCATTERING IN NUCLEAR EMULSIONS.
See Abstr. 3806